DEPARTMENT OF HEALTH & HUMAN SERVICES

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December 15, 2005
HETA 2001-0445
Interim Letter VII

Mike Winkler, President
Administrative and Residual Employees Union Local 4200
705 North Mountain Road, Suite A211
Newington, Connecticut 06111

Dear Mr. Winkler:

This interim letter and attachments serve to provide updates on the NIOSH medical and environmental surveys at 25 Sigourney Street, Hartford, Connecticut. It includes an expedited presentation and initial analysis of data collected in August, 2005, that was requested by Commissioner Galvin of the State of Connecticut Department of Public Health in his letter of October 3, 2005. An updated report and recommendations were also requested to be provided in December, 2005, by Governor Rell in her letter of September 16, 2005. Thus, in addition to the usual sharing of this interim letter with stakeholders, copies of this letter and attachments will also be sent to Governor Rell, Commisioner Fleming of the Department of Public Works, Commisioner Yelmini of the Department of Administrative Services and Commisioner Galvin of the Department of Public Health.

The attached update takes the form of questions and answers based on our analyses completed to date. Appendices with 2004 and 2005 data available to date, which may be useful in addressing questions which we have not posed in the first section of the update, are also attached.

The major question that all the stakeholders are asking is: should the building be closed and the employees relocated?

As is more fully described in the attached report, our survey results alone do not support a recommendation to relocate all occupants from the 25 Sigourney Street building. However, it would be prudent to relocate individual employees who are continuing to experience significant adverse consequences of the building environment in which they work. This would be consistent with sound occupational medical practice in industries with occupational asthma risk, in which there is ample evidence that removal from implicated exposures improves health outcome. Medical surveillance of the workforce is critical for recognition of early illness at a time when removal may result in cure, in contrast to allowing or requiring that disease progress to impairment before secondary prevention is undertaken.

Primary prevention requires continued attention to prevent and repair water damage at the Sigourney Street building, which is the evident explanation for building-related health problems among employees at the Sigourney Street Building. The Institute of Medicine (IOM) of the National Academy of Sciences published a comprehensive review of literature in late 2004 entitled *Damp Indoor Spaces and Health*. The review concluded that there is sufficient evidence of associations of building dampness and presence of mold in damp indoor environments with nasal and throat symptoms, wheeze, cough, and asthma symptoms in sensitized people; that there is suggestive evidence of associations with shortness of breath and development of asthma; and

that there is insufficient evidence of associations with skin symptoms and fatigue. The review also concluded that there is sufficient evidence of an association between the presence of mold or bacteria in damp indoor environments and hypersensitivity pneumonitis in susceptible persons. These symptoms, as well as asthma and hypersensitivity pneumonitis, are found in excess in the Sigourney Street building employees.

While only suggestive evidence was available at the time of the IOM review to link new-onset asthma to damp indoor spaces, NIOSH work with employees in the Sigourney Street building has produced new evidence indicating that new-onset building-related asthma can occur in a damp building. The 2001 survey results document that the risk of asthma increased 7.5 times after building occupancy compared to the risk in adulthood prior to occupancy (see Appendix D). Unfortunately, little information exists about the effect of remediation on this risk. The risk appears to be different for the subgroup of employees who have worked in the building for several years, in comparison to an apparently lower risk for employees newly hired after remediation.

There is no single environmental measurement that should be the sole basis of a decision to keep the building open, change occupant agencies, close it, or reopen it. The health assessments presented in this report do not provide an unambiguous answer to the question.

In light of the uncertainty of how to proceed, we suggest some principles:
1. Protect persons with persistent or potentially serious building-related illness with policies that enable appropriate protection from continued exposure.
2. Collect health information at regular intervals on persons who occupy the building so that decisions about remediation, risk, and risk management are based on data and can be systematically evaluated.
3. Communicate all information to building occupants so that they can make personal decisions with respect to facing potential risks associated with working in the building.
4. Delineate the basis of decisions made in the face of scientific uncertainty so that employees understand and can contribute to successful outcomes that are important for the missions and productivity of the affected state agencies.
5. Ensure that the repairs to the building have stopped the water incursions, and continue to monitor for and promptly remediate any water incursions, dampness or microbial contamination occurring anywhere in the building.

This is an expedited analysis of the data and is not complete. We welcome your questions and suggestions for our continued work on the information collected over the last three surveys (2001, 2004, and 2005). If we can be of additional assistance in the difficult decisions to be made, we remain willing to continue to prioritize this work and to partner with you and all other stakeholders in Connecticut.

If you have any questions regarding the information provided, please do not hesitate to contact us at 1-800-232-2114.

Sincerely,

Terri Pearce

Terri Pearce, Ph.D.
Respiratory Disease Hazard Evaluation
and Technical Assistance Program
Field Studies Branch
Division of Respiratory Disease Studies

cc:
Governor M. Jodi Rell
Commissioner, James Fleming, DPW
Commissioner, James Galvin, DPH
Commissioner, Pam Law, DRS
Commissioner, James M. Thomas, DEMHS
Commissioner, Patricia Wilson-Coker, DSS
Commissioner, Linda Yelmini, DAS
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Robert Rinker, CSEA
Eileen Storey, UCHC/DOEM
David Ward, DAS

DECEMBER 15, 2005
UPDATE ON
MEDICAL AND ENVIRONMENTAL SURVEYS
AT 25 SIGOURNEY STREET, HARTFORD, CONNECTICUT
HETA 2001-0445

In this update of the medical and environmental surveys at 25 Sigourney Street, Hartford, Connecticut, the first section has been organized in a question and answer format. Following this, there are five appendices: Appendix A gives the results of the August 2004 medical and environmental surveys; Appendix B gives the results of the August 2005 medical and environmental surveys; Appendix C gives comparisons across the 2002, 2004 and 2005 surveys of the floor dust levels, the floor fungal concentrations, and the fungal genera cultured from the floor dust; Appendix D is a paper published in 2005 in the journal *Environmental Health Perspectives* and is based on 2001 and 2002 questionnaire and medical surveys; and Appendix E is a manuscript in press in the journal *Indoor Air* which is based on 2001 and 2002 questionnaire and environmental surveys.

Background

A Health Hazard Evaluation request was submitted to NIOSH in July of 2001 by the Administrative and Residual Employees Union representing Connecticut state employees who work in the 25 Sigourney Street building in Hartford, Connecticut. Since 1994, employees working on the 15 occupied floors of the Sigourney Street building have reported recurrent water damage and respiratory health complaints. The building had problems with water incursion through leaks in the roof, around windows, and through sliding doors of terraces. There had been plumbing leaks on many floors, which had damaged interior walls. The building was found to be operating at negative pressure relative to the outdoors, which may have exacerbated water incursion. Water damage and mold contamination were worst in the upper floors. Individuals with post-occupancy onset asthma, hypersensitivity pneumonitis (HP), and sarcoidosis had been diagnosed and relocated to another facility. HP is an immune-mediated granulomatous lung disease which has been associated with fungal contamination, and has been found to co-exist with asthma in damp office buildings. Sarcoidosis is an immune-mediated granulomatous multisystem disease of unknown etiology.

As in 2001, there remains much that is unknown about relationships between indoor environmental quality and health. In many buildings across the country, occupants attribute health problems to building occupancy, yet scientists do not know what environmental measures account for these health problems. However, we do know that dampness is a public health problem which is associated with respiratory health problems and requires remediation.

NIOSH/CDC researchers conducted a series of investigations in the building in 2001, 2002, 2004, and 2005. Evaluations were done to assess the frequency of occupants with respiratory symptoms and medical test abnormalities; tabulate physician diagnoses of asthma, hypersensitivity pneumonitis and other respiratory conditions; evaluate risk factors for health problems; and assess responses as building improvements were put into place. NIOSH found that employees surveyed in 2001 had a 7.5-fold increase in incidence of asthma after starting work in the building, compared to their incidence of adult asthma prior to occupancy. In the

2002 NIOSH medical survey, abnormal lung function and/or breathing medication use was found in 67% of respiratory cases, 38% of participants with fewer symptoms, and 11% of the comparison group, with similar results for never smokers alone. The respiratory case definition was: three or more of five lower respiratory symptoms (wheeze/whistling in the chest, chest tightness, shortness of breath, coughing, or awakening by attack of breathing difficulty) occurring weekly over the past month; or at least two of: shortness of breath when hurrying on level ground or walking up a slight hill, fever and chills, flu-like achiness or achy joints occurring weekly over the past month; or current asthma with post-occupancy physician diagnosis; or physician-diagnosed HP or sarcoidosis. The fewer symptoms group included employees with any one or more of the lower respiratory or symptoms but not enough to reach the level of the respiratory case definition. The comparison group definition was: none of the specified respiratory case symptoms in the past year, and none of the specified respiratory case diagnoses (see Appendix D for details of the methods and results). Culturable fungi and endotoxin in floor dust were associated with work-related respiratory symptoms in an exposure-dependent manner (see Appendix E).

Internal and external repairs to the building began prior to the Health Hazard Evaluation request in 2001 and continued until the spring of 2004, when, upon completion of the designated repairs to the building by the Department of Public Works, a systematic cleaning of all floor surfaces and furnishings was accomplished with high-efficiency particulate filter vacuums. After the completion of the building repairs in 2004, NIOSH returned for additional rounds of questionnaire, medical, and environmental surveys in August 2004 and August 2005. This expedited update on the health status of building occupants and environmental assessments as assessed in the surveys of 2004 and 2005 is being provided in response to requests from Governor Rell in her letter of 9/16/05 and Commissioner Galvin in his letter of 10/3/05 to receive information in a short time frame, preferably by December. Results from the 2005 survey have not been previously reported, and only partial results from the 2004 survey have been previously reported. It should be noted that although this update provides an overview of the data collected in 2004 and 2005, full statistical and epidemiological analyses are not yet complete. Still, we hope that the State of Connecticut will find this interim report helpful in formulating policy for managing building-related health complaints.

Medical Surveys: Results and Discussion

A: Were symptomatic participants more likely to leave employment?

This question is important, because if people with health problems selectively leave employment it can cause the remaining population to appear more healthy. This "healthy worker effect" is often encountered in occupational epidemiology.

We used employee lists from 2004 and 2005 to identify the participants from the 2001 short questionnaire survey who had left employment. About 20% (179/888) of the 2001 participants had left employment. We compared the percentages of employees leaving employment among participants in the 2001 survey who had met the comparison group, fewer symptoms group, and respiratory case group definitions in that survey and found an increasing trend across the three symptom groups. The asymptomatic comparison group had the lowest percent that left

employment, the fewer symptoms group had an intermediate percent that left, and the respiratory case group had the highest percent that left employment (Table 1). Three of the 179 people who left employment did not provide sufficient information for this analysis.

Table 1. Comparison of percentages[A] of respiratory case group, the fewer symptoms group, and the comparison group who left employment after the 2001 survey

Employment status	Comparison group (n = 163)	Fewer symptoms group (n = 485)	Respiratory case group (n = 207)	Row total (n = 855[B])
Left building since 2001 (Column %)	28 (17%)	92 (19%)	56 (32%)	176

[A] Significantly increasing trend in column percents across the groups within group of people who left building since 2001 survey (Cochran-Armitage trend test p-value=0.01)
[B] This total is lower than 888 since some participants did not have sufficient information for classification.

For each of 13 symptoms (upper and lower respiratory, eye, skin, and systemic symptoms), we compared the percentages of people leaving employment among participants in the 2001 survey who reported no symptoms, symptoms in the last 12 months but not in the last 4 weeks, and symptoms weekly in the last 4 weeks. We found that, for attacks of shortness of breath, shortness of breath on hurrying or walking up-hill, and flu-like achiness, there was an increasing trend across the three symptom groups, where the group reporting symptoms weekly in the last 4 weeks had the highest proportion of people leaving employment (Cochran-Armitage trend test p-value=0.08, p=0.003, and p=0.02, respectively, for these three symptoms).

In summary, we found that symptomatic individuals were more likely to leave employment. Thus, evaluations of the remaining employee population in 2004 and 2005 may underestimate the true burden of illnesses in the original population studied in 2001.

B: As compared to the national and state populations, were there excesses of asthma and respiratory symptoms in building occupants in 2005?

We compared symptoms and reports of asthma to data from the adult U.S. population, based on NHANES III (the third National Health and Nutrition and Examination Survey) (Table 2) and found that current asthma was 3 times higher in the building occupants than would be expected based on their age, gender, race, and smoking status. For symptoms, building occupants had prevalence rates 1.4 to 2.9 times higher than the U.S. population. We also compared the prevalence of asthma in the building occupants to that reported for the adult population of Connecticut, based on data from the 2004 BRFSS (Behavioral Risk Factor Surveillance System). Building occupants reported a significantly higher prevalence of current asthma than the state population (prevalence ratio = 1.9; 95% confidence interval = 1.5-2.2).

Table 2. Comparison of health outcomes from the 2005 survey between 730 building occupants and the adult U.S. population (NHANES III[A])

Condition	No. observed	Prevalence ratio[B] (95% CI)
Ever diagnosed with asthma	151	2.6 (2.3-3.1)
Current asthma	113	3.0 (2.5-3.6)
Wheezing or whistling in your chest in the last 12 months	297	2.9 (2.6-3.3)
Shortness of breath when hurrying on the level or walking up a slight hill[C]	323	2.0 (1.8-2.2)
Sinusitis or sinus problems in the last 12 months	393	1.5 (1.3-1.6)
Stuffy, itchy or runny nose in the last 12 months	533	1.4 (1.3-1.5)
Watery, itchy eyes in the last 12 months	404	1.4 (1.3-1.5)

[A] The prevalence ratios were adjusted for age, gender, race, and smoking status.
[B] The prevalence ratio is calculated as the number of people with the outcome in the building occupants divided by the number of people expected to have the outcome based on U.S. population data.
[C] Our question pertained to the last 12 months

Thus, as was the case in the previous surveys of 2001 and 2004, there continue to be excesses in asthma and respiratory symptoms relative to state and national comparison groups. It should be noted that there are some limitations to these data. There might be differences between the occupant and external comparison populations that affect prevalence of symptoms and diagnoses. For example, publicity and concern about the workplace might possibly affect likelihood to report symptoms and seek medical care, as well as the diagnostic approaches of physicians in the community. Still, these findings are of concern.

C: Did the 39 participants who first occupied the building in 2004 and 2005 report a lower prevalence of symptoms in 2005 than longer term participants?

Using 2005 survey responses, we compared the percentage of participants with symptoms in the last 12 months between longer term employees (building occupancy before 2004) and the shorter term employees (building occupancy in 2004 or 2005). For all symptoms, the shorter term employees had lower prevalences than the longer term employees. These differences were statistically significant for wheeze, chest tightness, throat symptoms and flu-like achiness (Figures 1 and 2). We only have information for about half (39/81)of the employees who first occupied the building in 2004 or 2005, since there were 81 people on the 2005 survey employee list whose names had not been on the 2004 survey employee list.

Figure 1. Prevalences of lower respiratory symptom in the 2005 survey by occupancy period

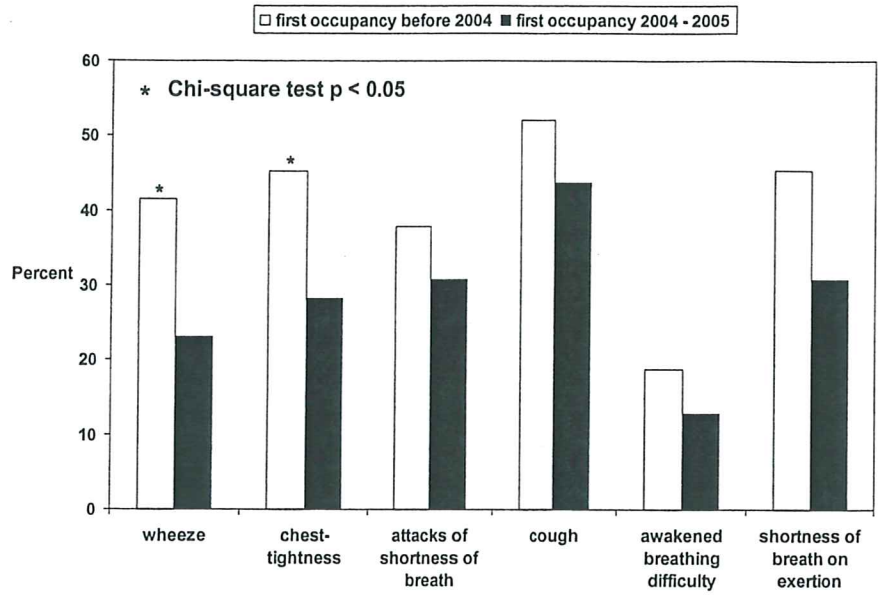
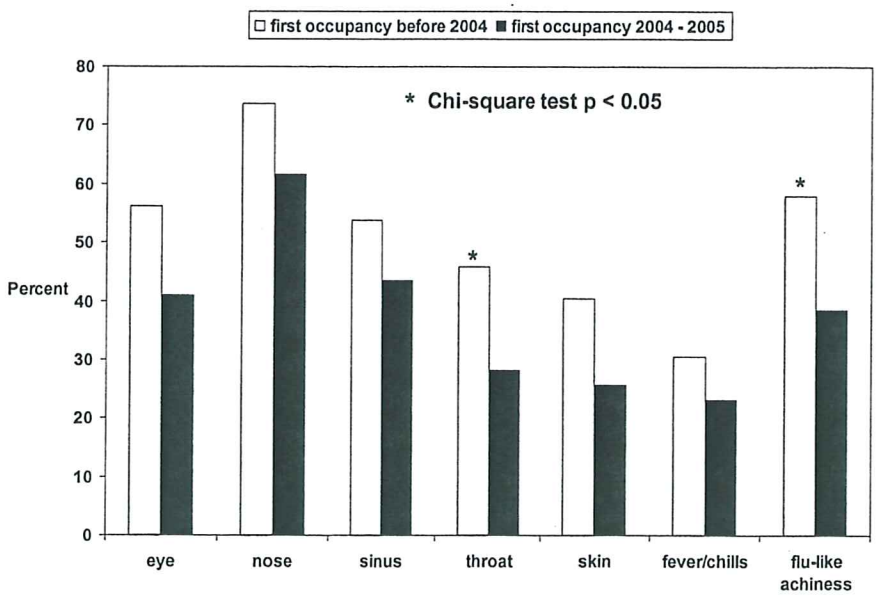


Figure 2. Prevalences of upper respiratory, eye, skin, and systemic symptoms in the 2005 survey by occupancy period



Thus, there was a general trend for the 39 participants who occupied the building in 2004 and 2005 to report a lower prevalence of symptoms in 2005 than those with longer-term occupancy. This may mean that the building environment is healthier; alternatively it may take longer than one or two years for health effects to develop.

D: Among employees who participated in all three surveys (2001, 2004, and 2005), what were prevalences of individual symptoms over time?

We used the questionnaire data from the 354 participants in all three surveys to examine changes in symptom prevalences over time. This group provides information that is not affected by population changes such as people leaving or entering employment. As depicted in Figures 3-5, the trend over the three time periods was generally different for symptoms occurring weekly in the last 4 weeks as compared to those with symptoms anytime during the last 12 months (but not weekly in the last 4 weeks). We made this comparison because we assume that people with frequent symptoms in the last 4 weeks have more troubling health problems than people with less frequent or recent symptoms. For many symptoms, prevalence of weekly occurrence during the last 4 weeks showed continuous increases in both 2004 and 2005 as compared to 2001. The greatest relative increases in symptom prevalence between 2001 and 2005 were for "shortness of breath on exertion," (Figure 3) "rash and itchy skin," (Figure 4) and "flu-like achiness." (Figure 5) In contrast, the prevalence of most symptoms occurring in the last 12 months (but not weekly in the last 4 weeks) tended to decrease in 2004 as compared to 2001, and then increase in 2005, but not to the level of 2001 (except for chest tightness which had highest prevalence in 2005). Thus, a variety of self-reported symptoms persisted during 2004 and 2005 among longer-term employees who had participated in the 2001 survey.

Figure 3. Prevalences of lower respiratory symptoms among those who participated in all three surveys

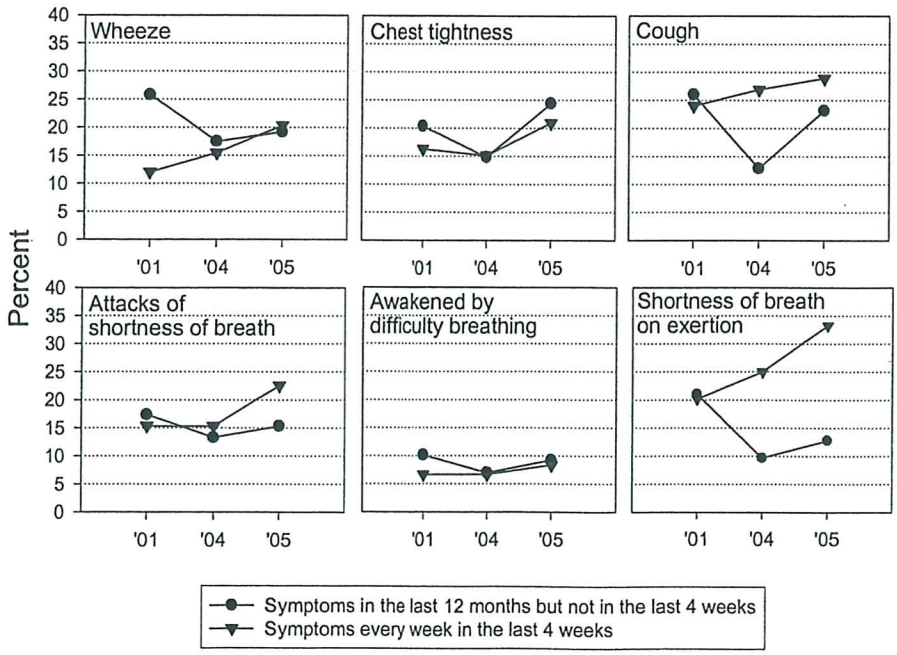


Figure 4. Prevalences of upper respiratory, eye and skin symptoms among those who participated in all three surveys

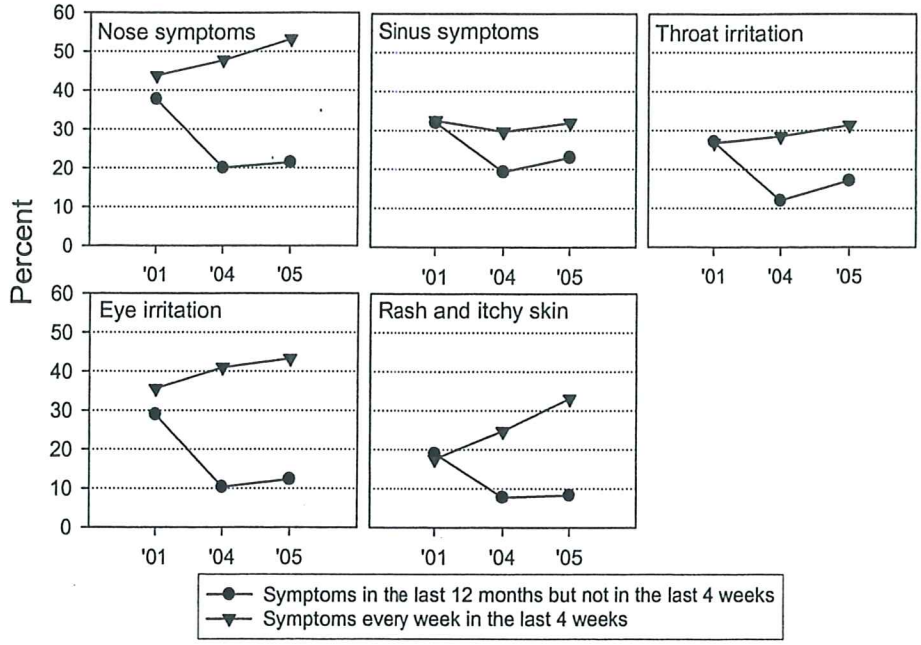
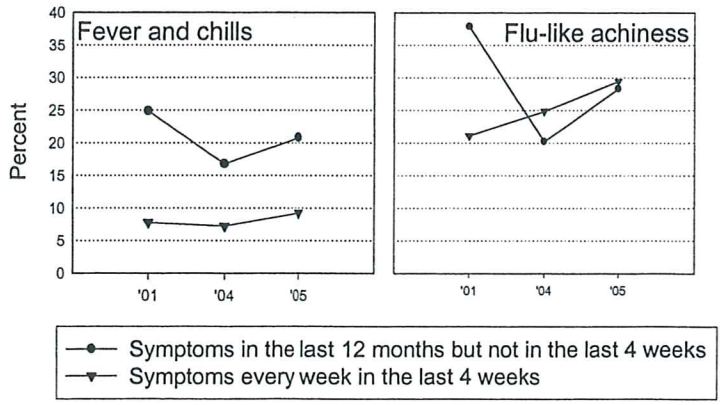


Figure 5. Prevalences of systemic symptoms among those who participated in all three surveys.



E: Among employees who participated in all three surveys, what was the pattern of movement between meeting the respiratory case group, fewer symptom group, or comparison group definitions?

We categorized each of the participants for each survey as meeting the comparison group (category 0), fewer symptoms group (category 1) or respiratory case group (category 2) definitions. Of the 354 participants in all three surveys, 341 had sufficient information for this categorization. We then used the rank of symptom categories to examine changes over time by

applying a generalized linear model. We found that the average rank was higher in 2005 than either 2001 or 2004 (p-values < 0.002). This means that more people changed to a higher symptom category than to a lower symptom category in 2005.

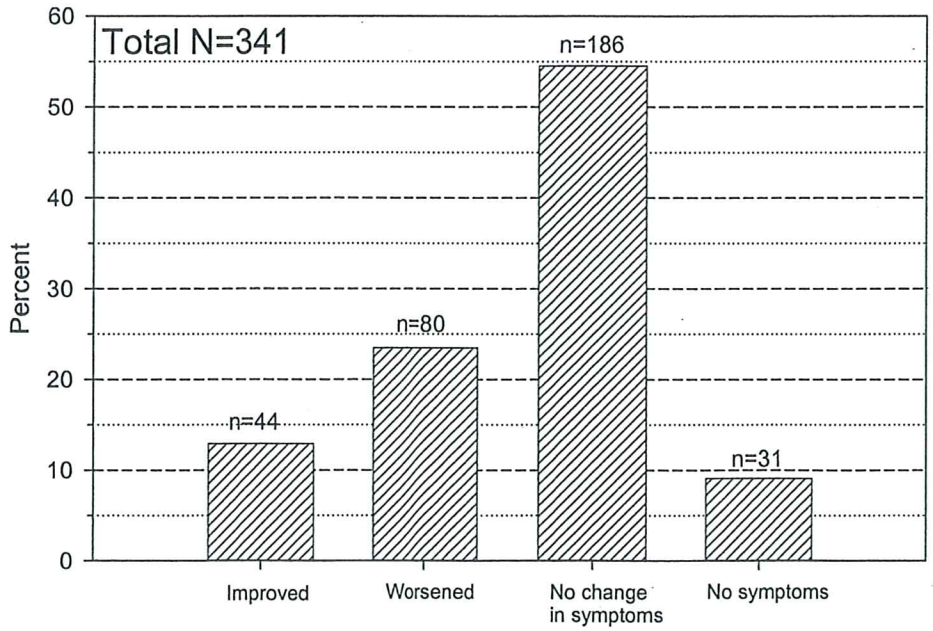
In another analysis we created groupings of the symptom categories for 2001 and 2005 (Table 3). We assigned each of the 341 participants with sufficient information to one of the groupings and found the largest group (about 55%) of the participants were in the "no change in symptoms" category. More people "worsened" (23%) than "improved" (13%). Only 9% of the participants had "no symptoms" in both years (Figure 6).

Table 3. Description of the 4 category groupings used in the analysis for Figure 6

Improved		Worsened		No change in symptoms		No symptoms	
2001 category	2005 category	2001 category	2005 category	2001 category	2005 category	2001 category	2005 category
2	1	0	1	1	1	0	0
1	0	1	2	2	2	-	-
2	0	0	2	-	-	-	-

* Category 0: comparison group (no symptoms); category 1: fewer symptoms group; category 3: respiratory case group.

Figure 6. Percent of 341 participants in all three surveys, in each of four symptom category groupings.



F: Did survey participants report new symptoms with onset in 2005?

New symptoms reported by both shorter term employees (building occupancy in 2004 and 2005) and longer term employees (building occupancy before 2004) who participated in the 2005

questionnaire survey. From 4 to 10 of the 39 shorter term employees and from 15 to 51 of the 703 longer term employees reported symptom onset of specific symptoms in 2005. Thus, new symptoms were reported by employees who had occupied the building before and after remediation.

We found a high proportion of missing symptoms onset dates for the participants who reported symptoms. For the short term employees, 18 to 60% of the participants with symptoms did not give onset dates, while for the longer term employees, 50 to 72% of the participants with symptoms did not give onset dates. Therefore, we cannot accurately compare proportions of onset in 2005 between longer term and shorter term employee participants.

G: Were there any new reports of doctor-diagnosed asthma, HP, or sarcoidosis in 2004 or 2005?

We merged the questionnaire data from the 2004 and 2005 surveys and examined diagnoses of asthma, HP, and sarcoidosis by year of building occupancy. It should be noted that these diagnoses were self-reported by study participants; NIOSH does not possess specific information about how participants' physicians made these diagnoses or whether these diagnoses were medically linked to building occupancy. For asthma, there were 10 diagnoses in 2004 and 8 in 2005. All of these 18 employees had first occupied the building between 1994 and 2003. In reviewing the reported lower respiratory symptom onset date given in the 2005 questionnaire survey, we found that 9 of the 18 new asthma cases had reported respiratory symptoms with onset between 1999 and 2004. For HP there were 2 diagnoses in 2004 (one of these cases reported symptom onset in 2003 and the other reported symptom onset in 2004) and 1 diagnosis in 2005 (this HP case reported symptom onset in 2003). All 3 of these employees had first occupied the building between 1994 and 1996. For sarcoidosis there was one reported diagnosis in 2004 with systemic symptom onset also reported to be in 2004. The employee had first occupied the building in 1999. No new cases were reported in 2005.

We found that none of the 45 participants first employed in 2004 or 2005 reported new diagnoses of any of these diseases either in 2004 or 2005 (One of the 45 had missing information for post-occupancy asthma).

H: Did the objective measures of lung function change over time in those employees who participated in at least two surveys?

Spirometry measures the volume of air exhaled in a forced expiration and the speed at which it is expelled. Abnormal results can occur in a broad range of diseases. In the case of asthma, spirometry is often normal between asthma attacks and can become abnormal during an attack or when asthma is not well-controlled. One hundred and thirty eight employees had spirometry both during the 2002 survey and either the 2004 or 2005 follow-up surveys. Of these, 118 had normal spirometry test results and 20 had abnormal spirometry test results in 2002. Sixteen of the 20 people had spirometry test results which remained abnormal and 4 had spirometry test results that became normal during follow-up. Additionally, 7 of the 118 participants who had first tested normal, changed to testing abnormal during follow-up. Using a matched pair analysis, these changes were not statistically significant.

Of the 21 employees who completed spirometry in only the 2004 and 2005 medical surveys, 18 had normal spirometry test results in both surveys; two had test results that changed from abnormal to normal; and one had abnormal test results in both surveys.

Methacholine testing assesses airways twitchiness or bronchial hyperreactivity (BHR), which is typically abnormal in people with active asthma. The result is summarized by the PC_{20}, which is the provocative concentration of methacholine that induces a 20% drop in a measure of lung function called the forced expiratory volume in one second (FEV_1). The lower the PC_{20}, the greater the degree of airways twitchiness. We defined BHR as a PC_{20} of $\leq$4.0 mg/mL, and borderline BHR as a PC_{20} between 4.1 and 16.0 mg/mL. One hundred and one employees had a methacholine test both during the 2002 survey and either the 2004 or 2005 follow-up surveys. Among these participants, results for 78 people were normal and stayed normal. During follow-up, 12 employees had increased airway twitchiness (a lower PC_{20}). Of these 12 participants, 4 changed from having normal test results to having borderline BHR; 4 changed from having borderline BHR to having BHR; 3 had borderline BHR in 2002 and at follow-up; and one participants had BHR in 2002 and at follow-up. During follow-up, decreased airway twitchiness (a higher PC_{20}) was shown by 11 participants. Seven of these 11 participants changed from having borderline BHR to having normal test results; 1 changed from having BHR to having a normal test results; and 3 had BHR in 2002 and at follow-up.

We also found no significant methacholine changes in those 23 employees who had methacholine challenge tests in only the 2004 and 2005 surveys. In these 2004-2005 participants, results for 21 people were normal and stayed normal. One participant who had a normal result in 2004 became borderline abnormal in 2005; and one participant who had borderline BHR in 2004 had a normal test result in 2005.

Since medications prescribed for asthma can improve both spirometry and methacholine results, we determined their use at each survey. However, we found no statistically significant changes in the reported use of asthma medications from survey to survey.

Thus, the health status of participants as indicated by spirometry and methacholine challenge testing remained similar in the follow-up surveys as compared to the initial 2002 survey. Medication use also stayed the same.

I: Did allergen skin test reactivity change from 2002 to 2004-2005?

Allergen Skin Tests were done to determine the reactivity of each employee to several types of allergens, including molds (*Dematiaceae* mix, *Aspergillus* mix, and *Penicillium* mix) and general allergens [dust mite mix (*Dermatophagoides farinae* and *D. pteronyssinus*), German cockroach (*Blattella germanica*), cat hair, seven grass mix, ragweed mix, common weed mix, eight Eastern tree mix)]. One hundred and thirty-one employees completed the allergen skin testing both during the 2002 survey and either the 2004 or 2005 follow-up surveys. Of these, 76 employees had a positive skin test to one or more general allergens in 2002. During follow-up, 19 became normal (no positive skin tests), while 11 employees with no positive skin tests in 2002 developed one or more positive skin tests during follow-up. These changes were not statistically significant.

The results of the mold allergen skin prick testing showed that 2 of the 104 participants who showed no reactivity to the molds in 2002 became reactive during follow-up testing in 2004 or 2005. However 20 of the 27 participants who showed reactivity to the molds in 2002 were no longer reactive to the molds during follow-up testing in 2004 or 2005. Using a matched pair analysis, this decrease in mold reactivity was statistically significant ($p < 0.0001$).

Thus, skin test reactivity to common airborne allergens did not change. However, prevalence of reactivity to the mold allergenic extracts tested decreased. It is unclear whether this change has anything to do with building conditions.

Environmental Surveys: Results and Discussion

A: Have the major building repairs completed in 2004 stopped dampness problems in the building?

Employees indicated on their August 2005 questionnaires that the building still had leaks. Other dampness issues mentioned were leaking from pipes in the ceiling, plumbing problems in the restrooms, and condensation issues from the building being kept too cold. In April 2005 leaks in the 19th floor law library and the atrium were being addressed, in July 2005 during refurbishing of the 5th floor cafeteria, water-damaged material with possible mold contamination was found and replaced, and in October 2005, heavy rains resulted in some leaks and some wetted carpet tiles were removed. These reports suggest that despite the large investment made in remediation prior to the spring of 2004, the Sigourney Street building may have ongoing water damage.

No environmental measurement is known to predict health hazard in buildings which have had water incursion. Accordingly, the environmental measurements reported here were not made with the intention of interpreting risk. They were made in an effort to better understand how dampness causes excess chest illness in building occupants and whether measuring specific components of dust might be useful in predicting health outcomes. In 2001, we did find associations between culturable fungi and endotoxin in floor dust and prevalence rates of respiratory symptoms that improve when away from the building (Appendix E). However, we don't know from the analyses to date whether these measurements in 2004 and 2005 still correlate with rates of respiratory outcomes. We don't know whether the components of dust that we measure are the agents that may cause respiratory disease excess, or markers of another agent, or reflections of higher levels that may have existed in the past before the remediation and cleaning that occurred prior to our first measurements in 2002. Accordingly, these measurements describe what we found but do not have a clear interpretation at this time.

B: Did the amount of carpet dust (measured in grams per square meter) collected from floors change over the three surveys in 2002, 2004, and 2005?

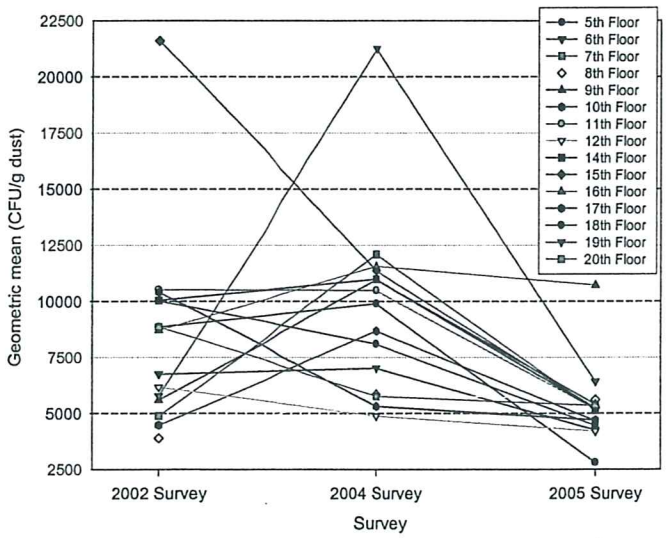
The amount of dust we collected from floor carpet in the 2004 survey was on average about twice (average=0.47 gram/m^2, range=0.26-0.79 gram/m^2) as much as the amount collected during the 2002 survey (average=0.25 gram/m^2, range=0.07-0.67 gram/m^2). We could not directly compare the amount of dust in the 2005 survey to that in the 2002 or 2004 surveys because the vacuum sampler used in 2005 was different (see Appendix C Table C1 for details).

Preliminary experiments at NIOSH indicate that the new vacuum sampler used in the 2005 survey collects more dust from carpeted floor than the vacuum samplers used in the 2002 and 2004 surveys. Conservatively, if we applied the smallest conversion factor (2.3) we found to the amount of dust collected from the Sigourney Street building in the 2005 survey, the levels would be similar to the levels of the 2002 survey.

C: Did the concentrations of culturable fungi in floor carpet dust change over the 2002, 2004, and 2005 surveys?

The overall concentrations of culturable fungi (cfu/g) in carpet dust from 2004 survey were slightly higher that that in 2002 survey. The overall concentrations of culturable fungi in dust from 2005 survey were somewhat lower than those in dust from 2002 and 2004 surveys (Figure 8). Appendix C, Table C2 gives the geometric mean, minimum, and maximum concentrations of fungi by floor.

Figure 8. Average concentration of total culturable fungi per gram of carpet dust by floor



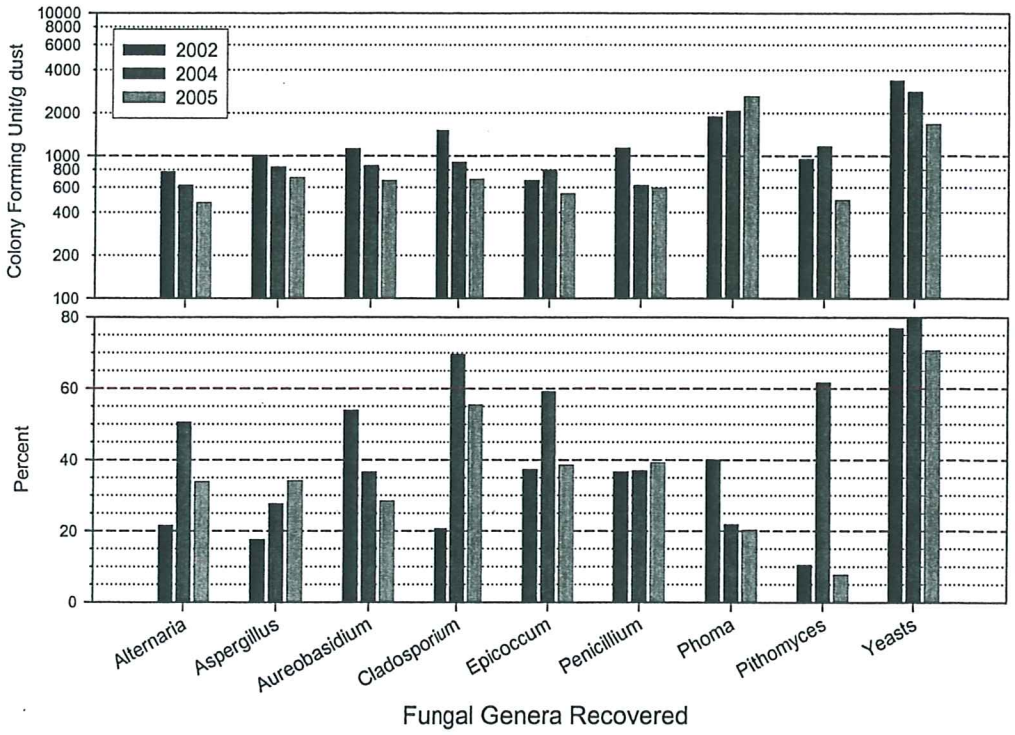
D: Did the pattern and the concentration of fungal genera found in carpet dust change over the 2002, 2004, and 2005 surveys?

There were some changes over time in the percentage of the total carpet dust samples in which specific fungal genera were cultured (Figure 9). There were no large changes in the concentrations of the fungal genera over time.

A total of 38 fungal genera were identified in carpet dust samples from at least one of the three surveys (See Appendix C, Figures C1-C3). Of the 19 fungal genera which were found in all three surveys, we considered a genus that was found in at least 30% of the samples in any of the three surveys to be a predominant genus. *Alternaria*, *Aspergillus*, *Aureobasidium*, *Cladosporium*, *Epicoccum*, *Penicillium*, *Phoma*, *Phthomyces*, and yeasts were predominant fungi over the three surveys. The concentrations of the predominant fungi, in general, slightly

decreased in the 2004 and 2005 surveys. Most of those fungi except for *Aureobasidium* and *Phoma* were found in more of the samples from the 2004 and 2005 surveys as compared to the 2002 survey, with *Cladosporium* showing one of the largest increases. For *Phoma*, the concentration was slightly increased although *Phoma* was found in fewer samples from the 2004 and 2005 surveys.

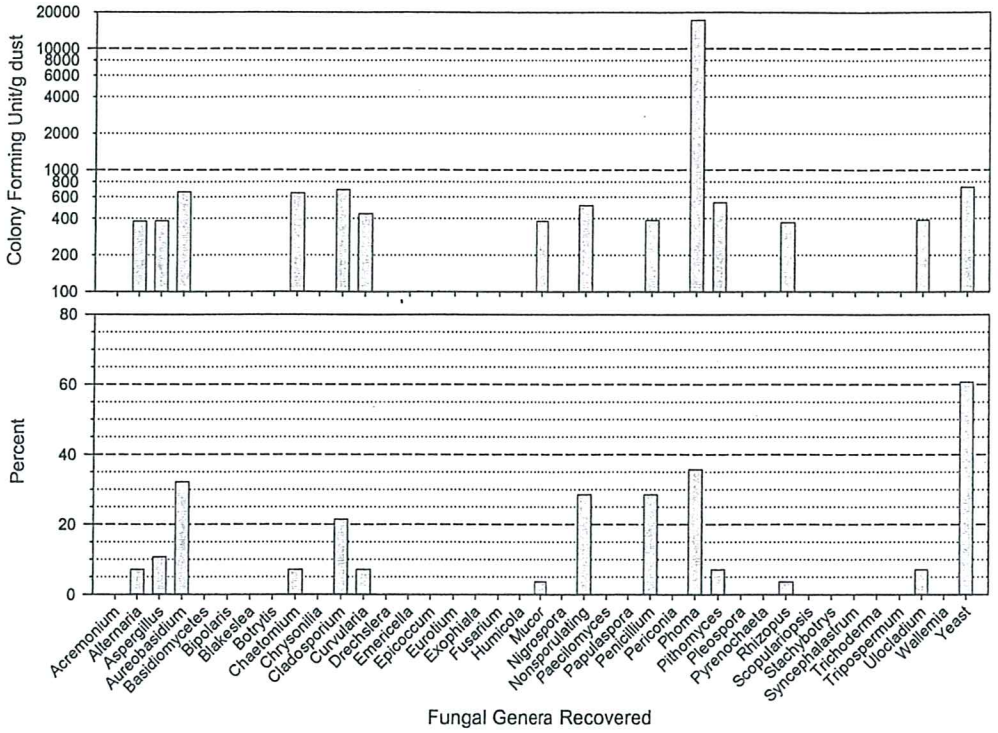
Figure 9. Geometric mean concentrations of culturable fungi and percent of samples with fungi recovered for the fungal genera which were predominant



E: Were the pattern and concentration of fungi in dust from cubicle partitions different from those found in floor dust in 2005?

We selected 30 workstations on floors 14 - 19 (five per floor) for vacuum sampling of dust contained on the fabric-covered portions of the cubicle partitions. Sufficient dust was collected from 28 of the partitions to allow for analysis of the culturable fungi concentration per gram of dust. Comparing Figure 9 showing the 2005 floor dust fungal results to Figure 10 below, we see that *Phoma* was more frequently found in the partition dust (35% of samples) as compared to the floor dust (20% of samples). The concentration of *Phoma* per gram of dust was higher for the partitions (17,173 cfu/g) as compared to that in the floor dust (2,619 cfu/g).

Figure 10. Geometric mean concentrations of culturable fungi and percent of samples with fungi recovered from the partition dust samples in the 2005 survey



Summary and Conclusions

The results of the 2004 and 2005 surveys present a mixed picture. There is reason for both optimism and concern. Reports of continuing water and dampness problems in the building are a cause for concern. In a report recently commissioned by the CDC, the Institute of Medicine (IOM) performed a comprehensive review of the scientific literature evaluating relationships between damp indoor spaces, indoor mold contamination, and human health. The resulting report *Damp Indoor Spaces and Health* was published in 2004 and remains the most current and authoritative source of information on this subject. The IOM found sufficient evidence to link upper respiratory tract symptoms (such as nasal congestion, sneezing, runny or itchy nose, and throat irritation) to damp indoor environments and mold (with exposure to mold often determined in studies by self-report). Similarly, there was sufficient evidence for a link with the lower respiratory tract symptoms of cough and wheeze. Sufficient evidence was also found for a link between damp indoor environments, mold, and asthma symptoms in sensitized people with asthma. Finally, there was also sufficient evidence for an association between mold exposure and hypersensitivity pneumonitis in susceptible people. The IOM found insufficient information on which to base quantitative recommendations for either the appropriate level of dampness reduction in buildings or the "safe" level of exposure to dampness-related agents. However, it was recommended that buildings should be designed, operated, and maintained to prevent water intrusion and excessive moisture accumulation when possible. To improve health and safety communication in the building and engage all occupants in maintaining a health environment, indoor air quality teams should be established in each agency occupying office space in the building.

Data describing self-reported symptoms and diagnoses among building occupants are cause for both optimism and concern. Relatively lower levels of self-reported symptoms and absence of new respiratory disease diagnoses among more recent occupants are encouraging. However, the number of recent occupants studied was small and the time of follow-up was short. In contrast, persisting and even increased levels of symptoms, as well as new respiratory disease diagnoses in longer-term occupants, are of concern. There are some limitations to these self-reported data. As is the case in many studies, most individuals with symptoms do not have medical diagnoses documented as underlying causes. This does not mean that these individuals don't have symptoms; just that these symptoms often cannot be attributed to a defined disease process. Also, we cannot rule out that publicity and concern about the building have in some way affected occupants' likelihood to report symptoms on a questionnaire. With regard to self-reported diagnoses, we do not know exactly what tests or evaluations participants' physicians used to make the diagnoses. Finally, we cannot say with certainty for any individual whether their individual disease diagnosis was caused by building occupancy. Still, given the levels of self-reported symptoms and disease diagnoses in the population, and given the associations we have found between symptoms and levels of fungi and endotoxin in floor dust (Appendix E), it is important that potentially building-related medical complaints be taken seriously. Individuals with such complaints should be carefully evaluated for diagnosis and treatment by appropriate medical personnel. We also recommend continued follow-up surveillance of building occupants by either standardized questionnaire or clinical interview to monitor the occurrence of potentially building-related symptoms and disease diagnoses. If patterns of symptoms or diagnoses suggest specific building problems, these should be addressed.

Based on the results of our surveys alone, we do not currently recommend relocation of all occupants from the 25 Sigourney Street building. As recommended by the IOM, the building should continue to be operated and maintained to prevent water intrusion and excessive moisture accumulation. When water intrusion or moisture accumulation is discovered, the source should be identified and eliminated as soon as possible to reduce the possibility of problematic microbial growth and building-material degradation. If dampness results in excessive microbial contamination of building materials and furnishings, they should be cleaned and decontaminated or eliminated, as has been done over the past several years. Despite these efforts, it is important to recognize that there are subsets of individuals who have been and could be adversely affected by building occupancy. Individuals with medical problems such as asthma related to building occupancy or HP related to building occupancy should receive standard medical therapy and efforts should be made to assure that dampness problems and sources of microbial contamination should be removed from their work environment. The IOM report notes that, in some cases of HP, if efforts to remove mold from a building are unsuccessful in relieving symptoms, then the patient may need to move to another building. This will also be the situation for some individuals with asthma. We suggest trial relocation of such individuals to buildings without histories of problems with water and dampness. Follow-up on responses to these relocations can help to guide decisions about long term relocation. If individuals with these medical conditions are returned to the building, they should be monitored over time to document that they maintain their health.

Appendix A:
August 2004 Survey Results

Questionnaire. During August 2004, we offered the 2001 health symptom questionnaire to all building employees. We supplemented on-site self-administration of the questionnaire with a mailed version to those not participating on-site, in order to increase the response rate. To evaluate potential participation bias in 2004, NIOSH interviewers also contacted 70 randomly selected non-participants by telephone to ask about their respiratory symptoms.

Medical tests. The 356 cases and comparison group employees originally invited to participate in the 2002 survey, and still currently employed in the building, were offered a repeat extended health questionnaire and medical testing during the second and third weeks of August 2004. The 15 employees who had not been part of the original invitees, but who had asked to take part in the 2002 survey were also invited in 2004. Medical tests included spirometry, methacholine challenge/bronchodilator, and allergen skin prick tests.

Environmental sampling. During the first week of August 2004, floor and chair dusts were collected at each case and comparison group employee's workstation. A two square meter area of carpet was vacuumed for 5 minutes according to a standard sampling protocol. For the employees whose workstations had changed within the past four weeks, carpets in the previous work stations were also sampled. Upon arrival at NIOSH, the dust samples were processed according to a standard protocol. The dust samples were homogenized and aliquots prepared for delivery to commercial laboratories conducting analysis of biological contaminants. Those included in the present report are: endotoxin, culturable fungi, and dog and cat allergens.

Questionnaire Survey Results

The overall participation was 771 out of 1155 employees and represented a 67 percent participation rate. Overall demographics for the participants are shown in Table A1.

Table A1. Demographics of August 2004 questionnaire participants

Age (Mean ± SD)	47.8 ± 8.0
Gender (% Female)	445/769 (57.9%)
Building tenure (Mean ± SD)	8.0 ± 3.0
Race (% White)	561/760 (73.8%)
Smoking status	
Current	83/766 (10.8%)
Former	165/766 (21.5%)
Never	518/766 (67.6%)

Prevalences of doctor-diagnosed conditions are shown in Table A2 below.

Table A2. Prevalences of doctor-diagnosed conditions (August 2004)

Condition	Prevalence (%)
Asthma	153/769 (19.9%)
Current asthma	109/762 (14.3%)
Post-occupancy asthma	72/765 (9.4%)
Post-occupancy, current asthma	55/760 (7.2%)
Hypersensitivity pneumonitis	11/763 (1.4%)
Sarcoidosis	6/767 (0.8%)

We compared the prevalence of asthma in the Sigourney Street building to the prevalence of asthma in adults in Connecticut using results from the 2003 Behavioral Risk Factor Surveillance System administered by the Centers for Disease Control (see Table A3 below).

Table A3. Comparison of asthma for 25 Sigourney Street with BRFSS* (August 2004)

Condition	Total	No. observed	No. expected	Obs/Exp (95% CI)
Ever diagnosed with asthma	767	153	94.5	1.6 (1.4-1.9)
Current asthma	760	109	64.2	1.7 (1.4-2.0)

*adjusted for gender

We also compared the prevalences of asthma and symptoms in the Sigourney Street participants to those for the U.S. adult population using data from The 3rd National Health and Nutrition Examination Survey (NHANES III) (see Table A4).

Table A4. Comparison of selected health outcomes for 25 Sigourney Street with NHANES III (August 2004)*

Condition	n	No. observed	No. expected	Obs/Exp (95% CI)
Ever diagnosed with asthma	713	145	55.5	2.6 (2.2-3.1)
Current asthma	707	104	36.0	2.9 (2.4-3.5)
Wheezing or whistling in your chest in the last 12 months	711	225	98.6	2.3 (2.0-2.6)
Shortness of breath when hurrying on the level or walking up a slight hill**	711	240	153.5	1.6 (1.4-1.8)
Sinusitis or sinus problems in the last 12 months	715	358	266.1	1.3 (1.2-1.5)
Stuffy, itchy or runny nose in the last 12 months	712	484	380.4	1.3 (1.2-1.4)
Watery, itchy eyes in the last 12 months	712	356	287.3	1.2 (1.1-1.4)

* The prevalence ratios were adjusted for age, gender, race, and smoking status.

**Our question pertained to the last 12 months

Table A5 presents the data from 2004 that deals with specific symptoms in the last 12 months and with improvement away from work in the building.

Table A5. Prevalence of symptoms in the last 12 months and of symptoms that improve away from work (August 2004)

Symptoms present in the last 12 months	Prevalence of symptoms (%)	Prevalence of symptoms which improved away from work (%)
Lower Respiratory Symptoms		
Wheeze or whistling in chest	239/766 (31.2)	146/763 (19.1)
Chest tightness	224/758 (29.6)	120/752 (16.0)
Shortness of breath	198/760 (26.1)	124/754 (16.5)
Coughing attack	291/762 (38.2)	184/757 (24.3)
Awakened by an attack of breathing difficulty	98/766 (12.8)	45/761 (5.9)
Upper Respiratory Symptoms		
Stuffy, itchy or runny nose	515/767 (67.1)	277/756 (36.6)
Watery, itchy eyes	377/767 (49.2)	230/763 (30.1)
Sneezing	480/767 (62.6)	284/762 (37.3)
Sinusitis or sinus problems	377/771 (48.9)	198/762 (26.0)
Hoarseness or a dry, sore, or burning throat	306/768 (39.8)	187/764 (24.5)
Non-Respiratory Symptoms		
Episodes of fever and chills	199/763 (26.1)	66/755 (8.7)
Flu-like achiness or achy joints	329/766 (43.0)	90/756 (11.9)
Excessive fatigue	347/768 (45.2)	207/765 (27.1)
Headache	463/766 (60.4)	244/759 (32.2)
Drowsiness, memory, or concentration difficulty	386/766 (50.4)	238/762 (31.2)
Rash or itchy skin	224/762 (29.4)	103/759 (13.6)

Table A6 presents the data from 2004 of specific lower, upper, and non-respiratory symptoms that occurred weekly in the last 4 weeks.

Table A6. Prevalences of symptoms occurring weekly in the last 4 weeks (August 2004)

Symptoms occurring weekly in the last 4 weeks	Prevalence of symptoms (%)	Prevalence of symptoms which improved away from work (%)
Lower Respiratory Symptoms		
Wheeze or whistling in chest	128/765 (16.7)	93/763 (12.2)
Chest tightness	125/756 (16.5)	72/754 (9.6)
Shortness of breath	119/760 (15.7)	79/758 (10.4)
Coughing attack	192/765 (25.1)	141/765 (18.4)
Awakened by an attack of breathing difficulty	49/765 (6.4)	22/762 (2.9)
Upper Respiratory Symptoms		
Stuffy, itchy or runny nose	364/762 (47.8)	238/757 (31.4)
Watery, itchy eyes	295/768 (38.4)	198/768 (25.8)
Sneezing	379/767 (49.4)	259/763 (33.9)
Sinusitis or sinus problems	239/769 (31.1)	135/767 (17.6)
Hoarseness or a dry, sore, or burning throat	219/768 (28.5)	156/765 (20.4)
Non-Respiratory Symptoms		
Episodes of fever and chills	70/764 (9.2)	39/763 (5.1)
Flu-like achiness or achy joints	183/766 (23.9)	65/764 (8.5)
Excessive fatigue	297/763 (38.9)	180/760 (23.7)
Headache	311/767 (40.6)	181/764 (23.7)
Drowsiness, memory, or concentration difficulty	333/761 (43.8)	211/761 (27.7)
Rash or itchy skin	169/758 (22.3)	81/758 (10.7)

We compared the participants' symptom reports to those from workers in other office buildings using data from the Environmental Protection Agency's Building Assessment Survey and Evaluation (BASE) study that provides health data on workers from 100 buildings not known to have indoor air quality problems (see Table A7).

Table A7. Comparison of selected health outcomes for 25 Sigourney Street with BASE Study data (August 2004)

Symptom: At least once a week in the last 4 weeks and better away from work	Total	No. observed	No. expected	Obs/Exp (95% CI)
Wheeze	763	93	13.7	6.8 (5.5-8.3)
Chest tightness	754	72	16.6	4.3 (3.4-5.5)
Shortness of breath	758	79	13.6	5.8 (4.6-7.2)
Cough	765	141	39.0	3.6 (3.1-4.3)
Any lower respiratory symptom	751	201	59.3	3.4 (3.0-3.9)
Sneezing	763	259	87.0	3.0 (2.6-3.4)
Sore or dry throat	765	156	50.5	3.1 (2.6-3.6)
Headache*	764	181	127.6	1.4 (1.2-1.6)
Excessive fatigue*	760	180	123.1	1.5 (1.3-1.7)
Dry or itchy skin*	758	81	39.4	2.1 (1.7-2.6)
Tired or strained eyes*	756	301	174.6	1.7 (1.5-1.9)

*Expected numbers based on 41 building subset

Medical Survey Results

There were 196 participants in the August 2004 medical survey; 144 were either from the 2002 respiratory case group (87) or comparison group (57), 7 had asked to participate in 2002 and 45 had asked to participate in 2004. All 196 completed the long questionnaire, while fewer of the participants completed the medical testing. All participants were classified into three groups, respiratory cases, those with fewer symptoms, and a comparison group (those without symptoms) based on the 2004 questionnaire responses.

Overall demographics for the participants are shown in Table A8.

Table A8. Demographics of August 2004 medical survey participants

Age (Mean ± SD)	47.2 ± 7.8
Gender (% Female)	127/196 (64.8%)
Building tenure (Mean ± SD)	8.6 ± 2.1
Race (% White)	146/196 (74.5%)
Smoking status	
Current	24/196 (12.2%)
Former	45/196 (23.0%)
Never	127/196 (64.8%)

Table A9 presents results of objective tests of pulmonary function.

Table A9. Medical Test results (August 2004).

Variable	Respiratory Case Group	Fewer Sx Group	Comparison Group
Spirometry testing			
Normal	76% (64/84)	90% (54/60)	87% (26/30)
Abnormal			
Obstructed	13% (11/84)	8% (5/60)	10% (3/30)
Restricted	7% (6/84)	2% (1/60)	3% (1/30)
Mixed (obstructed and restricted)	1% (1/84)	0% (0/60)	0% (0/30)
Invalid	2% (2/84)	0% (0/60)	0% (0/30)
% Predicted FEV1 (Mean ± SD)	92 ± 14	99 ± 12	97 ± 10
% Predicted FVC (Mean ± SD)	97 ± 12	101 ± 13	99 ± 9
Methacholine challenge testing			
≤4 mg/ml (BHR)	16% (10/62)	0% (0/46)	0% (0/28)
> 4 and ≤16 mg/ml (borderline BHR)	6% (4/62)	4% (2/46)	4% (1/28)
> 16 mg/ml (normal)	77% (48/62)	96% (44/46)	96% (27/28)
Bronchodilator testing positive	20% (1/5)	50% (1/2)	None done
Abnormal methacholine challenge or bronchodilator tests	22% (15/67)	6% (3/48)	4% (1/28)
Any abnormal lung function test†	37% (27/73)	14% (7/49)	18% (5/28)

†Participants who had a normal spirometry and did not participate in the methacholine or bronchodilator testing were excluded.

The results for reported medication use and the combined prevalences for any medication use or abnormal lung function test are given in Table A10.

Table A10. Medication use (August 2004)

Variable	Respiratory Case Group	Fewer Sx Group	Comparison Group
Any medication for breathing problems	52% (49/95)	14% (9/66)	0% (0/35)
Oral steroid use in last 12 months	15% (14/95)	3% (2/66)	0% (0/35)
Inhaled steroid use in last four weeks	18% (17/95)	2% (1/66)	0% (0/35)
Beta-agonist use in last four weeks	29% (28/95)	0% (0/66)	0% (0/35)
Positive for any medication for breathing problems or abnormal lung function tests†	70% (59/84)	28% (14/50)	18% (5/28)

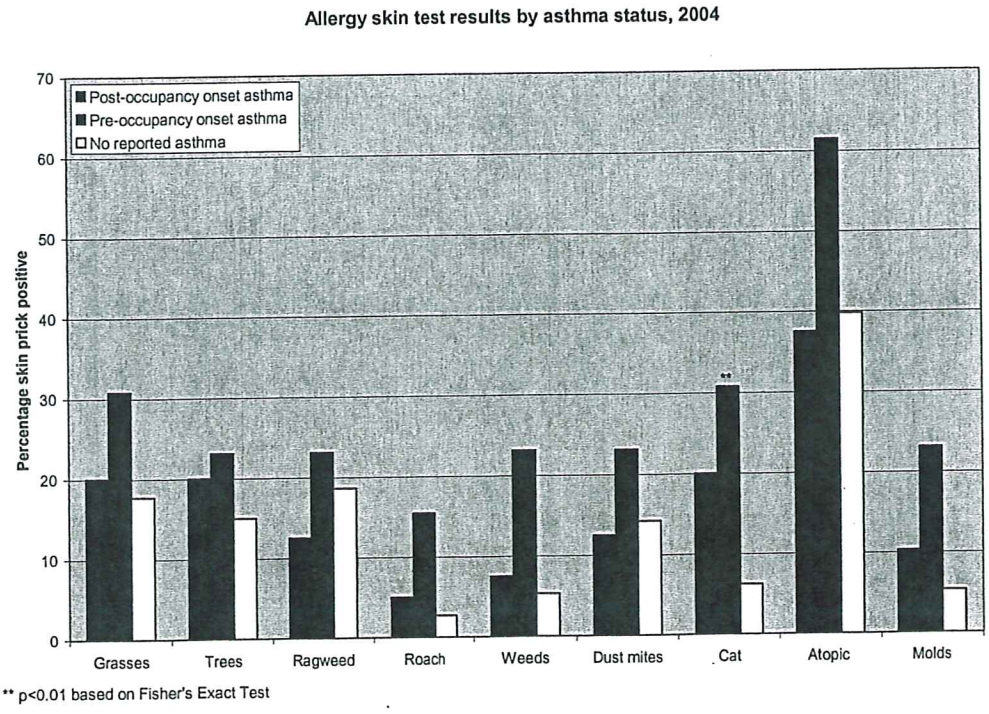
†Persons who had no medication use in the past 12 months and did not participate in medical testing were excluded

Skin prick allergy testing was offered to participants. Results from the 2004 testing are given in Table A11 and in Figure A1.

Table A11. Positive skin prick allergy test results by symptom group (August 2004)

Variable	Respiratory Case Group	Fewer Sx Group	Comparison Group
Allergens			
Dust mite mix	18% (14/80)	11% (6/56)	13% (4/30)
Cat	15% (12/80)	9% (5/56)	7% (2/30)
Cockroach	6% (5/80)	2% (1/56)	3% (1/30)
Tree mix	16% (13/80)	20% (11/56)	13% (4/30)
Grass mix	23% (18/80)	16% (9/56)	17% (5/30)
Weed mix	8% (6/80)	7% (4/56)	7% (2/30)
Ragweed	21% (17/80)	13% (7/56)	17% (5/30)
Atopic†	45% (36/80)	39% (22/56)	33% (10/30)
Mold mixes			
Penicillium	5% (4/79)	4% (2/56)	0% (0/30)
Alternaria/Cladosporium	10% (8/80)	2% (1/56)	3% (1/30)
Aspergillus	5% (4/80)	4% (2/56)	3% (1/30)
Any one or more mold mix positive	11% (9/79)	4% (2/56)	7% (2/30)

Figure A1. Allergen skin prick results compared between participants with post-occupancy onset doctor-diagnosed asthma, pre-occupancy onset doctor-diagnosed asthma, and no reported asthma (August 2004).



Results comparing symptom prevalences between 70 non-participants and the participants in the 2004 questionnaire survey are shown in Table A12.

Table A12. Prevalence of lower respiratory symptoms in the last 12 months for non-participants compared to participants (August 2004).

Symptom	Non-participants	Participants
Wheeze or whistling in chest	22/70 (31.4)	239/766 (31.2)
Chest tightness	16/70 (22.9)	224/758 (29.6)
Shortness of breath	15/69 (21.7)	198/760 (26.1)
Cough	29/70 (41.4)	291/762 (38.2)
Awakened by an attack of breathing difficulty	9/70 (12.9)	97/766 (12.7)

Environmental sampling results for the amount of carpet dust collected from the floors are given in Table A13 below.

Table A13. Amount of dust per square meter of carpet by floor of the building (August 2004)

Floor	Number of Samples	GM ± GSD* (grams)	Minimum	Maximum
Building Overall	279	0.47 ± 2.00	0.05	3.99
5	6	0.65 ± 1.98	0.30	2.24
6	23	0.43 ± 1.65	0.14	1.12
7	22	0.52 ± 1.53	0.24	1.27
8	16	0.61 ± 1.89	0.18	1.66
9	22	0.40 ± 1.94	0.11	1.07
10	25	0.38 ± 2.04	0.09	1.20
11	15	0.37 ± 2.17	0.08	1.21
12	14	0.40 ± 1.70	0.11	0.92
14	23	0.48 ± 1.74	0.15	1.19
15	25	0.37 ± 1.66	0.12	0.78
16	7	0.46 ± 1.66	0.19	1.07
17	46	0.79 ± 2.19	0.14	4.00
18	20	0.49 ± 1.65	0.10	0.98
19	14	0.26 ± 2.56	0.05	1.93
20	1	0.36	--	--

Environmental sampling results for the concentration of fungi cultured from carpet dust collected from the floors are given in Table A14 below.

Table A14. Concentration of fungi per gram of dust by floor of the building (August 2004)

Floor	Number of Samples	GM* ± GSD** (cfu†/gram)	Minimum (cfu†/gram)	Maximum (cfu†/gram)
Building overall	274	$8.66 \times 10^3 \pm 3.74$	2.00×10^2	2.98×10^6
5	6	$9.90 \times 10^3 \pm 3.45$	3.48×10^3	8.36×10^4
6	23	$7.02 \times 10^3 \pm 3.01$	1.60×10^3	2.33×10^5
7	21	$1.21 \times 10^4 \pm 5.12$	1.60×10^3	2.85×10^6
8	17	$5.86 \times 10^3 \pm 2.80$	1.14×10^3	3.32×10^4
9	22	$1.10 \times 10^4 \pm 4.25$	1.15×10^3	1.20×10^6
10	24	$8.68 \times 10^3 \pm 3.19$	2.00×10^3	3.16×10^5
11	14	$1.05 \times 10^4 \pm 2.91$	2.30×10^3	8.16×10^4
12	13	$4.88 \times 10^3 \pm 2.10$	1.53×10^3	1.45×10^4
14	20	$1.10 \times 10^4 \pm 3.39$	1.90×10^3	1.75×10^5
15	23	$1.14 \times 10^4 \pm 2.08$	3.60×10^3	6.16×10^4
16	8	$1.16 \times 10^4 \pm 5.27$	4.40×10^3	4.55×10^5
17	46	$5.31 \times 10^3 \pm 3.94$	2.00×10^2	5.52×10^5
18	20	$8.10 \times 10^3 \pm 2.22$	3.20×10^3	4.83×10^4
19	16	$2.13 \times 10^4 \pm 5.12$	2.67×10^3	2.98×10^6
20	1	5.77×10^3	5.77×10^3	5.77×10^3

*Geometric Mean
**Geometric Standard Deviation
†colony forming unit

Environmental sampling results for concentration of endotoxin, and cat and dog allergens in carpet dust collected from the floors are given in Table A15 below.

Table A15. Number of samples analyzed and amounts of specific analytes in floor dust per square meter by floor of the building based on the levels of endotoxin (EU/g), cat allergen (µg/g), and dog allergen (µg/g) collected in August 2004

Floor		Endotoxin (EU*/gram)			Cat Allergen (µg/g)			Dog Allergen (µg/g)		
	Number of samples	GM	Minimum	Maximum	GM	Minimum	Maximum	GM	Minimum	Maximum
Building overall	279	1.26×10^3	3.25×10^2	3.07×10^6	0.89	0.25	29.5	0.58	0.20	131.00
5	6	2.69×10^4	1.03×10^4	4.11×10^5	0.25	0.25	0.25	0.33	0.20	3.94
6	23	4.99×10^3	1.07×10^3	9.95×10^5	0.51	0.25	2.13	0.43	0.20	5.56
7	22	4.16×10^3	3.07×10^6	3.96×10^5	0.67	0.25	4.67	0.32	0.20	106.00
8	16	2.58×10^3	3.07×10^6	1.64×10^4	0.95	0.25	7.12	0.43	0.77	5.16
9	22	7.02×10^3	3.07×10^6	5.17×10^5	1.77	0.64	18.80	0.64	0.20	12.00
10	25	3.82×10^3	3.07×10^6	2.44×10^5	0.92	0.25	6.90	1.56	0.20	131.00
11	15	8.92×10^3	3.07×10^6	1.52×10^6	1.20	0.25	9.72	1.11	0.20	7.57
12	14	7.82×10^3	3.07×10^6	3.07×10^6	0.73	0.25	8.50	0.55	0.20	4.95
14	23	5.50×10^3	3.07×10^6	5.57×10^5	2.05	0.25	29.45	0.79	0.20	14.00
15	25	2.23×10^4	3.07×10^6	2.08×10^6	1.10	0.25	8.46	1.14	0.20	6.83
16	7	9.30×10^3	3.07×10^6	6.25×10^5	0.62	0.25	3.00	0.38	0.20	1.52
17	46	4.62×10^3	3.07×10^6	1.99×10^6	0.66	0.25	20.86	0.30	0.20	3.47
18	20	8.91×10^3	3.07×10^6	1.91×10^6	0.76	0.25	6.00	0.45	0.20	3.84
19	14	2.61×10^3	3.07×10^6	4.16×10^4	1.10	0.25	28.40	0.88	0.20	26.70
20	1	----	1.35×10^3	1.35×10^3	----	2.07	2.07	----	1.20	1.20

* Endotoxin Units

Environmental sampling results for concentration of endotoxin, and cat and dog allergens in chair dust collected from the floors are given in Table A16 below.

Table A16. Number of samples analyzed and amounts of specific analytes in chair dust by floor of the building based on the levels of endotoxin (EU/g), cat allergen (µg/g), and dog allergen (µg/g) collected in August 2004

Floor		Endotoxin (EU*/gram)			Cat Allergen (µg/g)			Dog Allergen (µg/g)		
	Number of samples	GM	Minimum	Maximum	GM	Minimum	Maximum	GM	Minimum	Maximum
Building overall	279	1.76×10^3	1.85	1.20×10^6	8.08	1.05	600	3.64	0.20	191
5	6	5.64×10^2	11.85	1.57×10^4	3.34	1.70	14.86	5.08	0.48	39.00
6	23	1.33×10^3	5.69	1.14×10^4	7.35	1.31	142.00	5.15	0.20	61.00
7	22	1.91×10^3	6.65	6.43×10^4	5.93	0.25	64.75	1.95	0.20	67.00
8	16	1.56×10^3	1.04×10^2	1.40×10^4	10.62	1.05	69.50	2.87	0.68	20.80
9	22	1.59×10^3	3.12	1.39×10^4	23.06	2.40	352.00	4.95	0.59	38.90
10	25	2.97×10^3	1.32×10^2	6.91×10^4	7.90	0.25	267.00	4.48	0.20	191.00
11	15	4.10×10^3	2.76×10^2	1.52×10^4	13.86	2.60	53.50	8.33	0.20	66.50
12	14	2.72×10^3	41.46	4.68×10^4	9.40	2.58	170.00	3.73	1.15	31.00
14	23	2.10×10^3	1.85	1.20×10^6	8.97	1.40	129.00	3.71	0.40	74.83
15	25	2.85×10^3	3.88×10^2	6.01×10^5	7.03	2.11	91.40	5.23	0.20	56.85
16	7	1.20×10^3	21.81	1.31×10^4	5.76	1.28	16.30	2.37	0.45	39.30
17	46	9.22×10^4	18.28	5.01×10^5	5.81	0.25	600.00	3.29	0.20	121.00
18	20	1.72×10^3	42.65	1.76×10^4	5.56	1.14	64.65	2.84	0.45	15.47
19	14	2.51×10^3	96.52	1.08×10^4	9.62	1.92	79.60	2.84	0.53	31.50
20	1	----	1.17×10^3	1.17×10^3	----	17.32	17.32	----	3.73	3.73

* Endotoxin Units

Table A17. Prevalence of fungal species (n=275) found in chair dust taken during the August 2004 survey (top 3 dominant types highlighted in bold)

Fungal Species	**N**	**%**
Acremonium blochii	1	<1%
Acremonium strictum	2	<1%
Alternaria alternata	**176**	**64**
Aspergillus flavus	2	<1%
Aspergillus fumigatus	4	1.5
Aspergillus glaucus	32	11.6
Aspergillus niger	36	13.1
Aspergillus ochraceus	1	<1%
Aspergillus species	2	<1%
Aspergillus sydowii	3	1.1
Aspergillus terreus	0	<1%
Aspergillus ustus	6	2.2
Aspergillus versicolor	8	2.9
Aureobasidium pullulans	**160**	**58.2**
Bipolaris australiensis	1	<1%
Botrytis cinerea	9	3.3
Chaetomium globosum	31	11.3
Cladosporium cladosporioides	102	37.1
Cladosporium herbarum	3	1.1
Cladosporium sphaerospermum	33	12
Curvularia cymbopogonis	0	<1%
Curvularia lunata	103	37.5
Curvularia trifolii	0	<1%
Epicoccum nigrum	138	50.2
Fusarium avenaceum	0	<1%
Fusarium oxysporum	4	1.5
Fusarium solani	5	1.8
Humicola fuscoatra	3	1.1
Mucor circinelloides	20	7.3
Mucor hiemalis	13	4.7
Mucor plumbeus	1	<1%
Mucor racemosus	1	<1%
Nigrospora sphaerica	15	5.5
Non-sporulating fungi	86	31.3
Paecilomyces variotii	4	1.5
Papulaspora irregularis	0	<1%
Penicillium aurantiogriseum	48	17.5
Penicillium chrysogenum	5	1.8
Penicillium brevicompactum	2	<1%
Penicillium citrinum	10	3.6
Penicillium crustosum	1	<1%
Penicillium decumbens	0	<1%
Penicillium glabrum	1	<1%
Penicillium expansum	4	1.5
Penicillium implicatum	1	<1%

Fungal Species	N	%
Penicillium lividum	0	<1%
Penicillium oxalicum	2	<1%
Penicillium paxilli	0	<1%
Penicillium melinii	5	1.8
Penicillium purpurogenum	3	1.1
Penicillium solitum	2	<1%
Penicillium species	3	1.1
Penicillium variabile	2	<1%
Penicillium waksmanii	1	<1%
Phoma exigua	0	<1%
Phoma glomerata	0	<1%
Phoma herbarum	61	22.2
Phoma medicaginis	42	15.3
Phoma/coelomycetes	0	<1%
Pithomyces chartarum	128	46.5
Pleospora herbarum	0	<1%
Rhizopus oryzae	2	<1%
Rhizopus stolonifer	14	5.1
Stachybotrys chartarum (atra)	3	1.1
Syncephalastrum racemosum	2	<1%
Trichoderma harzianum	0	<1%
Trichoderma koningii	10	3.6
Ulocladium atrum	3	1.1
Ulocaldium chartarum	20	7.3
Ulocladium botrytis	13	4.7
Wallemia sebi	4	1.5
Yeasts, Rhodotorula species	79	28.7
Yeasts, other	**181**	**65.8**

Appendix B:
August 2005 Survey Results

Questionnaire. In August 2005, we again offered the 2001 health symptom questionnaire to all employees. The questionnaire was web-based and run from a secure site from the Centers for Disease Control and Prevention in Atlanta. Each employee was given a unique entry code to enter the site and complete the questionnaire.

Medical tests. The 356 cases and comparison group employees defined in the 2001 survey and still currently employed in the building were offered an extended health questionnaire and medical testing. Additionally, employees who had not been part of the original invitees, but who had asked to take part in the 2002 and 2004 surveys were also invited, as were participants in the 2004 survey who met the case or comparison group definitions. Medical tests included spirometry, methacholine challenge tests or bronchodilator tests, and allergen skin prick tests. We also invited a group of 300 employees to participate in the extended questionnaire, allergen skin prick testing, nasal nitric oxide measurement, and nasal lavage. (The nasal test results are not included in the present report.) We selected these 300 employees by taking a random sample of about 20 employees on each floor of the building.

Environmental sampling. We sampled floor dust in the work stations of the 300 randomly-selected employees. These samples represented workstations on each floor. We selected 30 workstations on floors 14 - 19 (five per floor) for vacuum sampling of dust contained on the fabric-covered portions of the cubicle partitions. Sufficient dust was collected from 28 of the partitions to allow for analysis of the culturable fungi concentration per gram of dust. The samples were divided, and the dust was sent for measurement of specific analytes. The analytes included in the present report are: total culturable fungi, total culturable bacteria (gram positive and gram negative bacteria), and mycobacteria (for a third of the samples).

Questionnaire Survey Results

The web-based questionnaire was completed by 763 out of 1198 employees and represented a 64 percent participation rate. Overall demographics for the participants are shown in Table B1.

Table B1. Demographics of August 2005 questionnaire participants

Age (Mean ± SD)	48.6 ± 7.6
Gender (% Female)	418/763 (54.8%)
Building tenure (Mean ± SD)	8.7 ± 3.3
Race (% White)	574/763 (75.2%)
Smoking status	
Current	81/763 (10.6%)
Former	193/763 (25.3%)
Never	489/763 (64.1%)

Prevalences of doctor-diagnosed conditions are shown in Table B2 below.

Table B2. Prevalence rates of physician-diagnosed conditions (August 2005)

Condition	Prevalence (%)
Asthma	157/763 (20.6%)
Current asthma	118/763 (15.5%)
Post-occupancy asthma	77/748 (10.3%)
Post-occupancy, current asthma	60/753 (8.0%)
Hypersensitivity pneumonitis	16/763 (2.1%)
Sarcoidosis	2/763 (0.3%)

We compared the prevalence of asthma in the Sigourney Street building to the prevalence of asthma in adults in Connecticut using results from the 2003 Behavioral Risk Factor Surveillance System administered by the Centers for Disease Control (see Table B3 below).

Table B3. Comparison of asthma for 25 Sigourney Street with 2004 BRFSS (August 2005)

Condition	Total	No. observed	No. expected	Obs/Exp (95% CI)
Ever diagnosed with asthma	763	157	93.3	1.7 (1.4-2.0)
Current asthma	763	118	63.7	1.9 (1.5-2.2)

*adjusted for gender

We also compared the prevalences of asthma and symptoms in the Sigourney Street participants to those for the U.S. adult population using data from The 3rd National Health and Nutrition Examination Survey (NHANES III) (see Table B4).

Table B4. Comparison of health outcomes from the 2005 survey between 730 building occupants and the U.S. adult population (NHANES III[A])

Condition	No. observed	Prevalence ratio[B] (95% CI)
Ever diagnosed with asthma	151	2.6 (2.3-3.1)
Current asthma	113	3.0 (2.5-3.6)
Wheezing or whistling in your chest in the last 12 months	297	2.9 (2.6-3.3)
Shortness of breath when hurrying on the level or walking up a slight hill[C]	323	2.0 (1.8-2.2)
Sinusitis or sinus problems in the last 12 months	393	1.5 (1.3-1.6)
Stuffy, itchy or runny nose in the last 12 months	533	1.4 (1.3-1.5)
Watery, itchy eyes in the last 12 months	404	1.4 (1.3-1.5)

[A] The prevalence ratios were adjusted for age, gender, race, and smoking status.

[B] The prevalence ratio is calculated as the number of people with the outcome in the building occupants divided by the number of people expected to have the outcome based on U.S. population data.

[C] Our question pertained to the last 12 months

Table B5 presents the data from 2005 that deals with specific symptoms in the last 12 months and with improvement away from work in the building.

Table B5. Prevalence of symptoms in the last 12 months and of symptoms that improve away from work (August 2005)

Symptoms present in the last 12 months	Prevalence of symptoms (%)	Prevalence of symptoms which improved away from work (%)
Lower Respiratory Symptoms		
Wheeze or whistling in chest	311/763 (40.8)	192/763 (25.2)
Chest tightness	338/763 (44.3)	197/763 (25.8)
Shortness of breath	283/763 (37.1)	159/763 (20.8)
Coughing attack	394/763 (51.6)	239/763 (31.3)
Awakened by an attack of breathing difficulty	141/763 (18.5)	58/763 (7.6)
Upper Respiratory Symptoms		
Stuffy, itchy or runny nose	556/763 (72.9)	293/763 (38.4)
Watery, itchy eyes	422/763 (55.3)	257/763 (33.7)
Sneezing	506/763 (66.3)	302/763 (39.6)
Sinusitis or sinus problems	407/763 (53.3)	194/763 (25.4)
Hoarseness or a dry, sore, or burning throat	338/763 (44.3)	213/763 (27.9)
Non-Respiratory Symptoms		
Episodes of fever and chills	229/763 (30.0)	62/763 (8.1)
Flu-like achiness or achy joints	432/763 (56.6)	135/763 (17.7)
Excessive fatigue	428/763 (56.1)	234/763 (30.7)
Headache	485/763 (63.6)	230/763 (30.1)
Drowsiness, memory, or concentration difficulty	490/763 (64.2)	300/763 (39.3)
Rash or itchy skin	299/763 (39.2)	125/763 (16.4)

Table B6 provides the results of the questions on lower, upper, and non-respiratory symptoms that occurred weekly in the last 4 weeks.

Table B6. Prevalences of symptoms occurring weekly in the last 4 weeks (August 2005)

Symptoms occurring weekly in the last 4 weeks	Prevalence of symptoms (%)	Prevalence of symptoms which improved away from work (%)
Lower Respiratory Symptoms		
Wheeze or whistling in chest	163/763 (21.4)	114/763 (14.9)
Chest tightness	172/763 (22.5)	113/763 (14.8)
Shortness of breath	163/763 (21.4)	91/763 (11.9)
Coughing attack	214/763 (28.1)	144/763 (18.9)
Awakened by an attack of breathing difficulty	67/763 (8.8)	36/763 (4.7)
Upper Respiratory Symptoms		
Stuffy, itchy or runny nose	372/763 (48.8)	228/763 (29.9)
Watery, itchy eyes	328/763 (43.0)	217/763 (28.4)
Sneezing	370/763 (48.5)	248/763 (32.5)
Sinusitis or sinus problems	232/763 (30.4)	116/763 (15.2)
Hoarseness or a dry, sore, or burning throat	215/763 (28.2)	160/763 (21.0)
Non-Respiratory Symptoms		
Episodes of fever and chills	59/763 (7.7)	31/763 (4.1)
Flu-like achiness or achy joints	211/763 (27.7)	78/763 (10.2)
Excessive fatigue	352/763 (46.1)	207/763 (27.1)
Headache	289/763 (37.9)	158/763 (20.7)
Drowsiness, memory, or concentration difficulty	409/763 (53.6)	267/763 (35.0)
Rash or itchy skin	220/763 (28.8)	94/763 (12.3)

We compared the participants' symptom reports to those from workers in other office buildings using data from the Environmental Protection Agency's Building Assessment Survey and Evaluation (BASE) study that provides health data on workers from 100 buildings not known to have indoor air quality problems (see Table B7).

Table B7. Comparison of selected health outcomes for 25 Sigourney Street with BASE Study data (August 2005)

Symptom: At least once a week in the last 4 weeks and better away from work	Total	No. observed	No. expected	Obs/Exp (95% CI)
Wheeze	763	114	13.7	8.3 (6.9-10.0)
Chest tightness	763	113	16.8	6.7 (5.6-8.1)
Shortness of breath	763	91	13.7	6.6 (5.4-8.1)
Cough	763	144	38.9	3.7 (3.1-4.4)
Any lower respiratory symptom	763	243	60.3	4.0 (3.6-4.6)
Sneezing	763	248	87.0	2.9 (2.5-3.2)
Sore or dry throat	763	160	50.4	3.2 (2.7-3.7)
Headache*	763	158	127.4	1.2 (1.1-1.4)
Excessive fatigue*	763	207	123.6	1.7 (1.5-1.9)
Dry or itchy skin*	763	94	39.7	2.4 (1.9-2.9)
Tired or strained eyes*	763	298	176.3	1.7 (1.5-1.9)

*Expected numbers based on 41 building subset, not complete 100 building study

Medical Survey Results

There were 339 participants in the August 2005 medical survey; 112 were either 2001 cases or controls, 105 were 2004 cases or controls, 5 were 2002 volunteers, 27 had first asked to participate in 2004, 36 had newly asked to participate in 2005, and 54 were from the randomly selected group. Of the other invited participants 68 of them had also fallen into the randomly selected group. All 339 completed the long questionnaire, while fewer of the participants completed the medical testing.

Overall demographics for the participants are shown in Table B8.

Table B8. Demographics of August 2005 medical survey participants

Age (Mean ± SD)	49.2 ± 7.5
Gender (% Female)	200/339 (59.0%)
Building tenure (Mean ± SD)	9.3 ± 2.8
Race (% White)	262/339 (77.3%)
Smoking status	
Current	29/339 (8.6%)
Former	94/339 (27.7%)
Never	216/339 (63.7%)

All participants were classified into three groups, respiratory cases, those with fewer symptoms, and a comparison group (those without symptoms) based on the 2005 questionnaire responses.

Table B9 provides the values for the outcomes of the objective tests of pulmonary function.

Table B9. Objective medical test results by symptom category (August 2005)

Variable	Respiratory Case Group	Fewer Sx Group	Comparison Group
Spirometry testing			
Normal	74% (95/128)	88% (77/88)	79% (27/34)
Abnormal			
Obstructed	12% (15/128)	6% (5/88)	12% (4/34)
Restricted	11% (14/128)	6% (5/88)	6% (2/34)
Mixed (obstructed and restricted)	2% (3/128)	0% (0/88)	0% (0/34)
Invalid	1% (1/128)	1% (1/88)	3% (1/34)
% Predicted FEV1 (Mean ± SD)	92 ± 14	99 ± 12	98 ± 11
% Predicted FVC (Mean ± SD)	96 ± 13	100 ± 14	98 ± 10
Methacholine challenge testing			
≤4 mg/ml (BHR)	3% (3/92)	3% (2/71)	0% (0/31)
> 4 and ≤16 mg/ml (borderline BHR)	9% (8/92)	0% (0/71)	0% (0/31)
> 16 mg/ml (normal)	88% (81/92)	97% (69/71)	100% (31/31)
Bronchodilator testing positive	14% (2/14)	0% (0/1)	ND
Abnormal methacholine challenge or bronchodilator tests	12% (13/106)	3% (2/72)	0% (31/31)
Any abnormal lung function test†	39% (42/108)	16% (12/75)	19% (6/32)

†Participants who had a normal spirometry and did not participate in the methacholine or bronchodilator testing were excluded.

The results for reported medication use and the combined prevalences for any medication use or abnormal lung function test are given in Table B10.

Table B10. Medication use (August 2005)

Variable	Respiratory Case Group	Fewer Sx Group	Comparison Group
Any medication for breathing problems	26% (45/170)	3% (4/116)	0% (0/52)
Oral steroid use in last 12 months	6% (11/170)	1% (1/116)	0% (0/52)
Inhaled steroid use in last four weeks	12% (21/170)	0% (0/116)	0% (0/52)
Beta-agonist use in last four weeks	19% (32/170)	1% (1/116)	0% (0/52)
Positive for any medication for breathing problems or abnormal lung function tests†	58% (74/127)	19% (15/77)	19% (6/32)

†Persons who had no medication use in the past 12 months and did not participate in medical testing were excluded

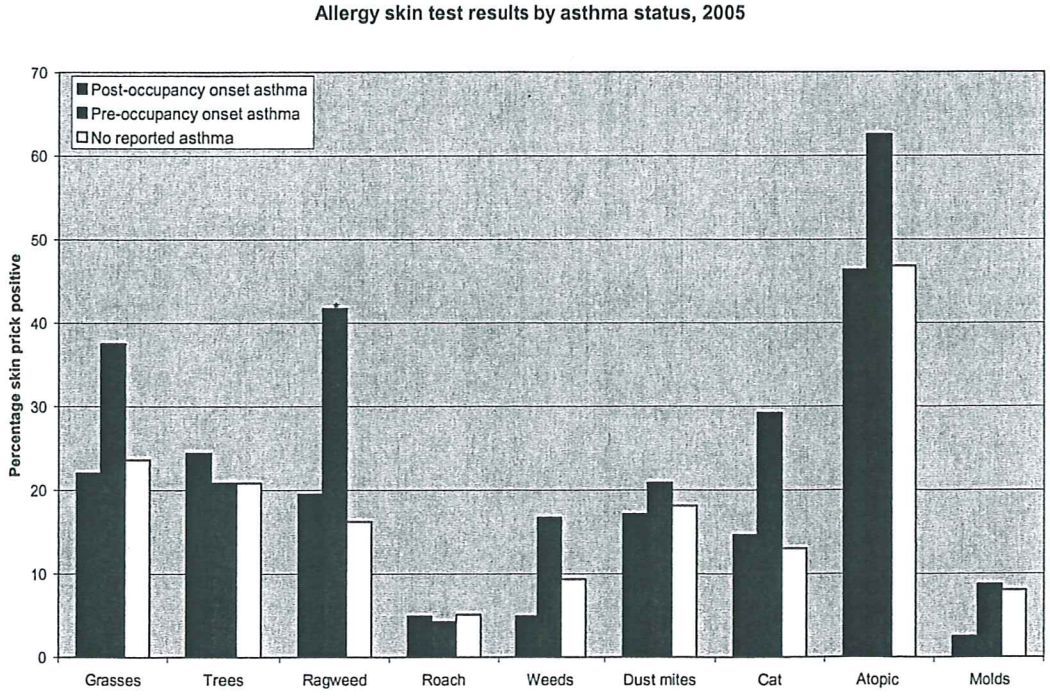
Skin prick allergy testing was offered to participants. Results from the 2005 testing are given in Table B11 and in Figure B1.

Table B11. Positive skin prick allergy test results by symptom group (August 2005).

Variable	Respiratory Case Group	Fewer Sx Group	Comparison Group
Allergens			
Dust mite mix	17% (24/140)	14% (14/99)	31% (13/42)
Cat	18% (25/140)	10% (10/99)	14% (6/42)
Cockroach	4% (6/140)	6% (6/99)	5% (2/42)
Tree mix	20% (28/140)	22% (22/99)	24% (10/42)
Grass mix	26% (36/140)	23% (23/99)	24% (10/42)
Weed mix	6% (9/140)	13% (13/99)	10% (4/42)
Ragweed	20% (28/140)	17% (17/99)	19% (8/42)
Atopic†	47% (66/140)	48% (48/99)	50% (21/42)
Mold mixes			
Penicillium	3% (4/138)	1% (1/97)	2% (1/41)
Alternaria/Cladosporium	5% (7/140)	6% (6/99)	0% (0/42)
Aspergillus	2% (3/140)	5% (5/99)	2% (1/42)
Any one or more mold mix positive	7% (10/138)	8% (8/97)	5% (2/41)

†Positive response to one or more of seven common allergens

Figure B1. Allergen skin prick results compared between participants with post-occupancy onset doctor-diagnosed asthma, pre-occupancy onset doctor-diagnosed asthma, and no reported asthma (August 2005).



* p<0.05 based on chi-square

Environmental sampling results for the amount of carpet dust collected from the floors are given in Table B12 below.

Table B12. Amount of dust* per square meter of carpet by floor of the building (August 2005)

Floor	Number of Samples	GM ± GSD* (grams)	Minimum	Maximum
Building overall	296	0.47 ± 3.16	0.02	10.02
5	20	1.81 ± 2.06	0.35	7.76
6	21	0.19 ± 2.17	0.06	1.14
7	21	0.31 ± 1.57	0.17	0.75
8	19	0.35 ± 1.99	0.08	1.09
9	21	0.27 ± 1.92	0.09	1.22
10	21	0.22 ± 2.05	0.04	0.95
11	21	0.27 ± 1.81	0.08	1.29
12	21	0.23 ± 1.84	0.07	0.76
14	20	0.20 ± 1.79	0.07	0.40
15	20	0.29 ± 2.51	0.04	1.54
16	21	0.61 ± 1.60	0.29	1.33
17	21	2.84 ± 2.14	0.69	10.02
18	21	1.35 ± 2.02	0.26	5.27
19	22	1.83 ± 2.26	0.36	10.02
20	6	0.19 ± 3.76	0.02	0.72

* A different type of vacuum sampler was used in the 2005 survey.

Environmental sampling results for the concentration of fungi cultured from carpet dust collected from the floors are given in Table B13 below.

Table B13. Amount of fungi per gram of dust by floor of the building (August 2005)

Floor	Number of Samples	GM* ± GSD** (cfu†/gram)	Minimum (cfu†/gram)	Maximum (cfu†/gram)
Building overall	297	$5.26 \times 10^3 \pm 3.58$	3.70×10^2	1.10×10^6
5	20	$2.81 \times 10^3 \pm 3.64$	3.70×10^2	1.21×10^5
6	21	$4.26 \times 10^3 \pm 2.31$	1.20×10^3	3.22×10^4
7	21	$5.14 \times 10^3 \pm 2.54$	1.11×10^3	3.08×10^4
8	19	$5.61 \times 10^3 \pm 2.84$	1.53×10^3	4.00×10^4
9	21	$5.30 \times 10^3 \pm 2.94$	8.00×10^2	1.42×10^5
10	21	$4.68 \times 10^3 \pm 4.59$	7.20×10^2	1.10×10^6
11	21	$5.19 \times 10^3 \pm 2.48$	8.00×10^2	3.05×10^4
12	21	$4.42 \times 10^3 \pm 1.86$	1.11×10^3	3.04×10^4
14	20	$5.86 \times 10^3 \pm 3.65$	1.15×10^3	2.83×10^5
15	20	$5.24 \times 10^3 \pm 2.17$	1.14×10^3	1.84×10^4
16	21	$1.07 \times 10^4 \pm 4.07$	2.00×10^3	1.54×10^5
17	21	$4.70 \times 10^3 \pm 6.23$	3.70×10^2	3.69×10^5
18	21	$5.25 \times 10^3 \pm 6.34$	3.80×10^2	1.34×10^5
19	22	$7.61 \times 10^3 \pm 4.85$	7.20×10^2	1.45×10^5
20	7	$5.35 \times 10^3 \pm 4.88$	1.43×10^3	1.13×10^5

*Geometric Mean
**Geometric Standard Deviation
†colony forming unit

Results of the culturable bacteria in carpet dust samples from the floors are shown in Table B14 below.

Table B14. Concentration of culturable bacteria per gram of dust by floor of the building (August 2005)

Floor	Number of Samples	Total Bacteria			Gram Negative Bacteria			Gram Positive Bacteria		
		GM* (cfu†/gram)	Minimum (cfu†/gram)	Maximum (cfu†/gram)	GM* (cfu†/gram)	Minimum (cfu†/gram)	Maximum (cfu†/gram)	GM* (cfu†/gram)	Minimum (cfu†/gram)	Maximum (cfu†/gram)
Building overall	291	3.24×10^5	7.40×10^3	1.20×10^8	0.70×10^4	3.80×10^2	2.78×10^7	1.91×10^5	7.10×10^2	5.40×10^7
5	20	2.14×10^5	1.20×10^4	1.00×10^7	0.19×10^4	3.80×10^2	1.70×10^4	1.35×10^5	8.90×10^3	1.70×10^6
6	21	5.33×10^5	4.80×10^4	2.10×10^7	2.00×10^4	7.60×10^2	9.20×10^5	2.28×10^5	6.70×10^3	1.40×10^7
7	21	3.84×10^5	3.10×10^4	7.60×10^6	0.38×10^4	3.70×10^2	2.34×10^5	4.14×10^5	3.20×10^4	3.40×10^6
8	19	1.93×10^6	1.40×10^5	6.80×10^7	1.37×10^5	1.60×10^3	2.78×10^7	5.68×10^5	1.20×10^5	3.60×10^7
9	21	5.31×10^5	8.00×10^4	2.80×10^7	0.51×10^4	3.60×10^2	1.10×10^6	2.63×10^5	7.70×10^4	2.20×10^7
10	20	2.95×10^5	1.40×10^4	1.10×10^8	0.20×10^4	3.70×10^2	7.90×10^4	1.24×10^5	7.60×10^3	1.60×10^7
11	21	3.88×10^5	1.70×10^4	1.40×10^7	0.86×10^4	7.70×10^2	1.11×10^6	3.03×10^5	2.70×10^4	3.60×10^6
12	20	2.21×10^5	7.40×10^3	1.80×10^7	0.51×10^4	3.70×10^2	3.04×10^6	1.41×10^5	6.90×10^3	2.50×10^6
14	21	5.56×10^5	2.20×10^4	2.40×10^7	1.48×10^4	3.70×10^2	1.30×10^6	2.89×10^5	1.30×10^4	2.40×10^7
15	19	3.85×10^5	3.60×10^4	9.60×10^6	1.68×10^4	1.20×10^3	8.90×10^5	2.76×10^5	2.60×10^4	9.20×10^6
16	19	4.07×10^5	3.00×10^4	2.20×10^7	1.14×10^4	7.40×10^2	3.30×10^6	2.95×10^5	2.60×10^4	5.80×10^6
17	21	2.33×10^5	1.70×10^4	1.20×10^8	0.20×10^4	3.80×10^2	2.67×10^4	1.07×10^5	4.10×10^3	5.40×10^7
18	21	0.83×10^5	9.30×10^3	6.90×10^5	0.10×10^4	3.70×10^2	2.60×10^4	0.55×10^5	7.10×10^2	1.10×10^6
19	22	1.07×10^5	8.90×10^3	4.60×10^6	0.30×10^4	3.80×10^2	3.20×10^4	0.86×10^5	3.90×10^3	1.90×10^6
20	5	3.30×10^5	1.10×10^4	3.90×10^6	7.03×10^4	3.80×10^3	1.30×10^6	1.12×10^5	1.50×10^4	9.00×10^6

*Geometric Mean
†colony forming unit

Mycobacteria (August 2005)

In addition to analyzing floor dust samples collected in 2005 for culturable bacteria concentration, we sent samples for laboratory analysis of culturable mycobacteria. At the time of this report, sample results had been received for approximately one third of the samples representing those collected on floors 16 through 20. No samples contained in this group were positive for culturable mycobacteria. Nine partition samples contained sufficient dust for culturable mycobacteria analysis. No samples were found to contain culturable mycobacteria within the limit of detection (approximately 400 cfu/gram).

Partition Dust (August 2005)

We randomly selected 30 workstations on floors 14 - 19 (five per floor) for vacuum sampling of dust contained on the fabric-covered portions of the cubicle partitions. The geometric mean amount of dust collected was 0.104 grams with the minimum amount in any sample being 0.030 grams and the maximum being 0.427 grams.

Sufficient dust was collected from 28 of the partitions to allow for analysis of the culturable fungal concentration per gram of dust. The geometric mean concentration of fungi was 4.40×10^3 cfu/gram with two samples being below the limit of detection. Of those samples with quantifiable amounts of culturable fungi, the minimum was 400 cfu/gram and the maximum was 3.54×10^5 cfu/gram.

Eleven samples contained sufficient dust for culturable bacteria analysis. The geometric mean concentration of culturable bacteria was 1.59×10^4 cfu/gram with all samples being above the limit of detection. The minimum concentration in the samples was 5.80×10^3 cfu/gram and the maximum was 4.60×10^4 cfu/gram. Gram-positive bacteria were the dominant culturable type.

Appendix C:
Comparisons of the Amount of Carpet Dust Recovered and the Culturable Fungi in Dust Over the Three Surveys

Table C1. Amount of dust per square meter of carpet by floor of the building across all three surveys

Floor	April 2002		August 2004		August 2005*	
	Number of Samples	Geometric Mean ± GSD** (grams)	Number of Samples	Geometric Mean ± GSD (grams)	Number of Samples	Geometric Mean ± GSD (grams)
Overall	338	0.25 ± 2.32	279	0.47 ± 2.00	296	0.47 ± 3.16
Floor:						
5	4	0.07 ± 1.18	6	0.65 ± 1.98	20	1.81 ± 2.06
6	30	0.30 ± 2.13	23	0.43 ± 1.65	21	0.19 ± 2.17
7	30	0.38 ± 1.86	22	0.52 ± 1.53	21	0.31 ± 1.57
8	21	0.30 ± 1.90	16	0.61 ± 1.89	19	0.35 ± 1.99
9	26	0.32 ± 1.89	22	0.40 ± 1.94	21	0.27 ± 1.92
10	28	0.20 ± 1.77	25	0.38 ± 2.04	21	0.22 ± 2.05
11	16	0.11 ± 2.14	15	0.37 ± 2.17	21	0.27 ± 1.81
12	19	0.07 ± 2.23	14	0.40 ± 1.70	21	0.23 ± 1.84
14	30	0.31 ± 1.62	23	0.48 ± 1.74	20	0.20 ± 1.79
15	27	0.36 ± 1.73	25	0.37 ± 1.66	20	0.29 ± 2.51
16	8	0.67 ± 1.64	7	0.46 ± 1.66	21	0.61 ± 1.60
17	58	0.18 ± 2.45	46	0.79 ± 2.19	21	2.84 ± 2.14
18	20	0.32 ± 1.83	20	0.49 ± 1.65	21	1.35 ± 2.02
19	20	0.31 ± 2.61	14	0.26 ± 2.56	22	1.83 ± 2.26
20	1	0.09	1	0.36	6	0.19 ± 3.76

* A different type of vacuum sampler was used in the 2005 survey.
** Geometric Standard Deviation

Table C2. Concentrations of total culturable fungi per gram of dust by floor of the building across all three surveys

Floor	April 2002		August 2004		August 2005	
	Number of Samples	Geometric Mean ± GSD* (CFU/gram)	Number of Samples	Geometric Mean ± GSD* (CFU/gram)	Number of Samples	Geometric Mean ± GSD* (CFU/gram)
Building overall	325	$7.76 \times 10^3 \pm 4.65$	274	$8.66 \times 10^3 \pm 3.74$	297	$5.26 \times 10^3 \pm 3.58$
5	4	$8.86 \times 10^3 \pm 1.32$	6	$9.90 \times 10^3 \pm 3.45$	20	$2.81 \times 10^3 \pm 3.64$
6	30	$6.75 \times 10^3 \pm 4.74$	23	$7.02 \times 10^3 \pm 3.01$	21	$4.26 \times 10^3 \pm 2.31$
7	30	$4.88 \times 10^3 \pm 3.94$	21	$1.21 \times 10^4 \pm 5.12$	21	$5.14 \times 10^3 \pm 2.54$
8	21	$3.89 \times 10^3 \pm 2.81$	17	$5.86 \times 10^3 \pm 2.80$	19	$5.61 \times 10^3 \pm 2.84$
9	26	$5.60 \times 10^3 \pm 5.48$	22	$1.10 \times 10^4 \pm 4.25$	21	$5.30 \times 10^3 \pm 2.94$
10	28	$4.48 \times 10^3 \pm 2.73$	24	$8.68 \times 10^3 \pm 3.19$	21	$4.68 \times 10^3 \pm 4.59$
11	14	$1.05 \times 10^4 \pm 5.18$	14	$1.05 \times 10^4 \pm 2.91$	21	$5.19 \times 10^3 \pm 2.48$
12	15	$6.17 \times 10^3 \pm 2.73$	13	$4.88 \times 10^3 \pm 2.10$	21	$4.42 \times 10^3 \pm 1.86$
14	28	$1.03 \times 10^4 \pm 6.53$	20	$1.10 \times 10^4 \pm 3.39$	20	$5.86 \times 10^3 \pm 3.65$
15	27	$2.16 \times 10^4 \pm 4.08$	23	$1.14 \times 10^4 \pm 2.08$	20	$5.24 \times 10^3 \pm 2.17$
16	8	$8.71 \times 10^3 \pm 5.47$	8	$1.16 \times 10^4 \pm 5.27$	21	$1.07 \times 10^4 \pm 4.07$
17	55	$1.04 \times 10^4 \pm 4.00$	46	$5.31 \times 10^3 \pm 3.94$	21	$4.70 \times 10^3 \pm 6.23$
18	19	$1.02 \times 10^4 \pm 8.28$	20	$8.10 \times 10^3 \pm 2.22$	21	$5.25 \times 10^3 \pm 6.34$
19	19	$5.78 \times 10^3 \pm 4.90$	16	$2.13 \times 10^4 \pm 5.12$	22	$7.61 \times 10^3 \pm 4.85$
20	1	8.86×10^3	1	5.77×10^3	7	$5.35 \times 10^3 \pm 4.88$

*Geometric Standard Deviation

Figure C1. Geometric mean concentrations of culturable fungal genera and percent of samples with fungi cultured from floor dust in the 2002 survey

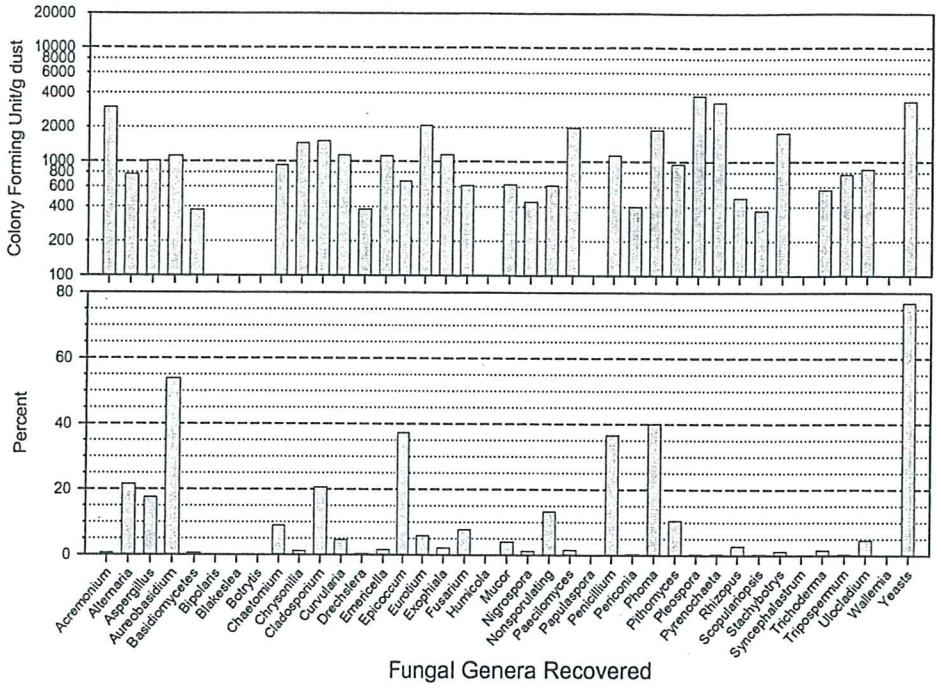


Figure C2. Geometric mean concentrations of culturable fungal genera and percent of samples with fungi cultured from floor dust in the 2004 survey

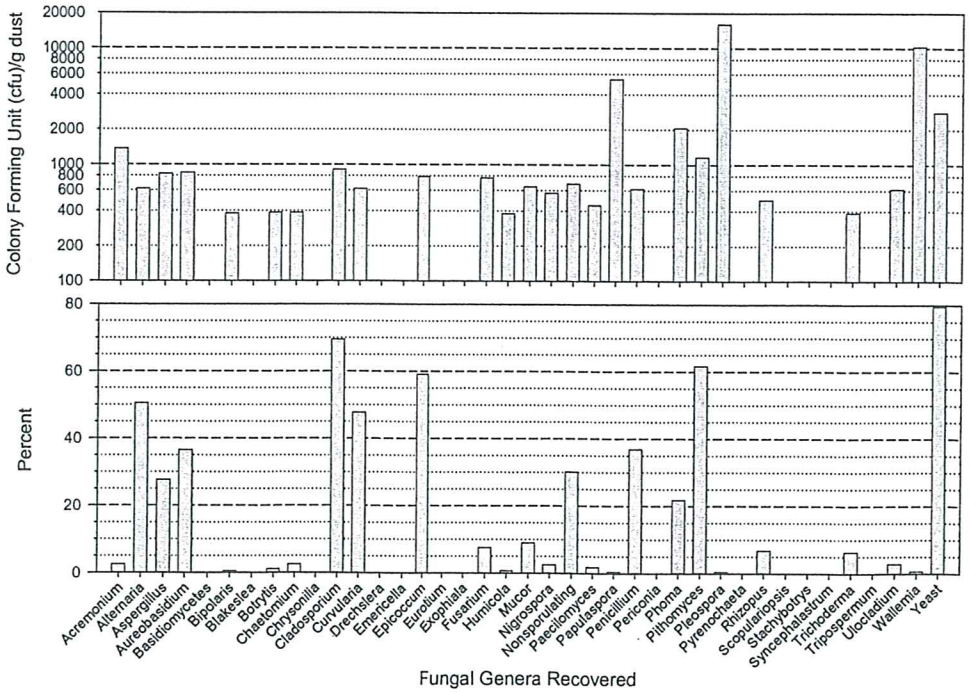
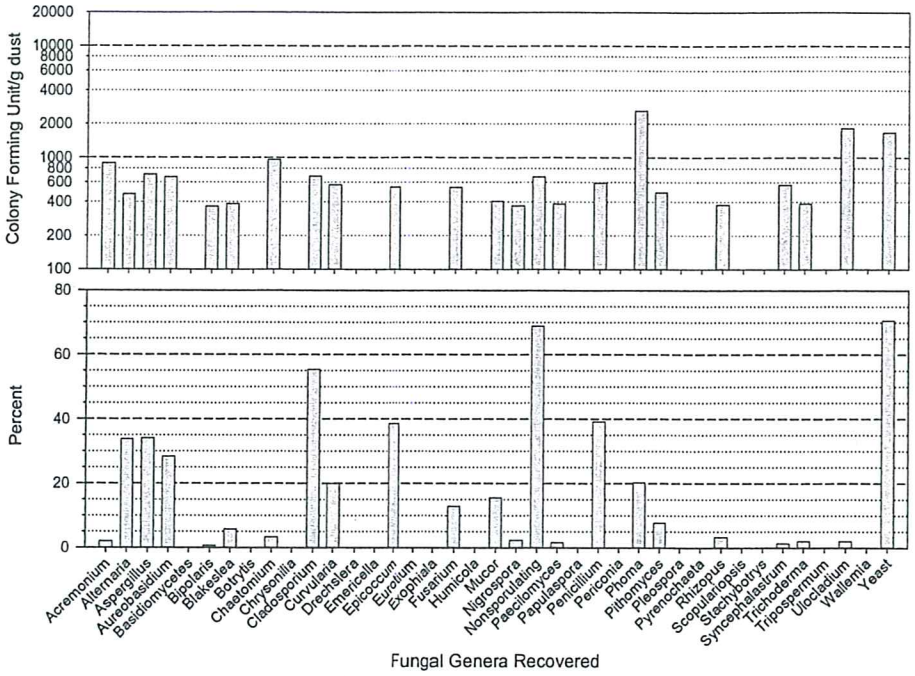


Figure C3. Geometric mean concentrations of culturable fungal genera and percent of samples with fungi cultured from floor dust in the 2005 survey



Appendix D:
A Published Scientific Paper
(Cox-Ganser et al. Respiratory Morbidity in Office Workers in a Water-damaged Building, *Environmental Health Perspectives* 2005: 113 (4); 485-490.